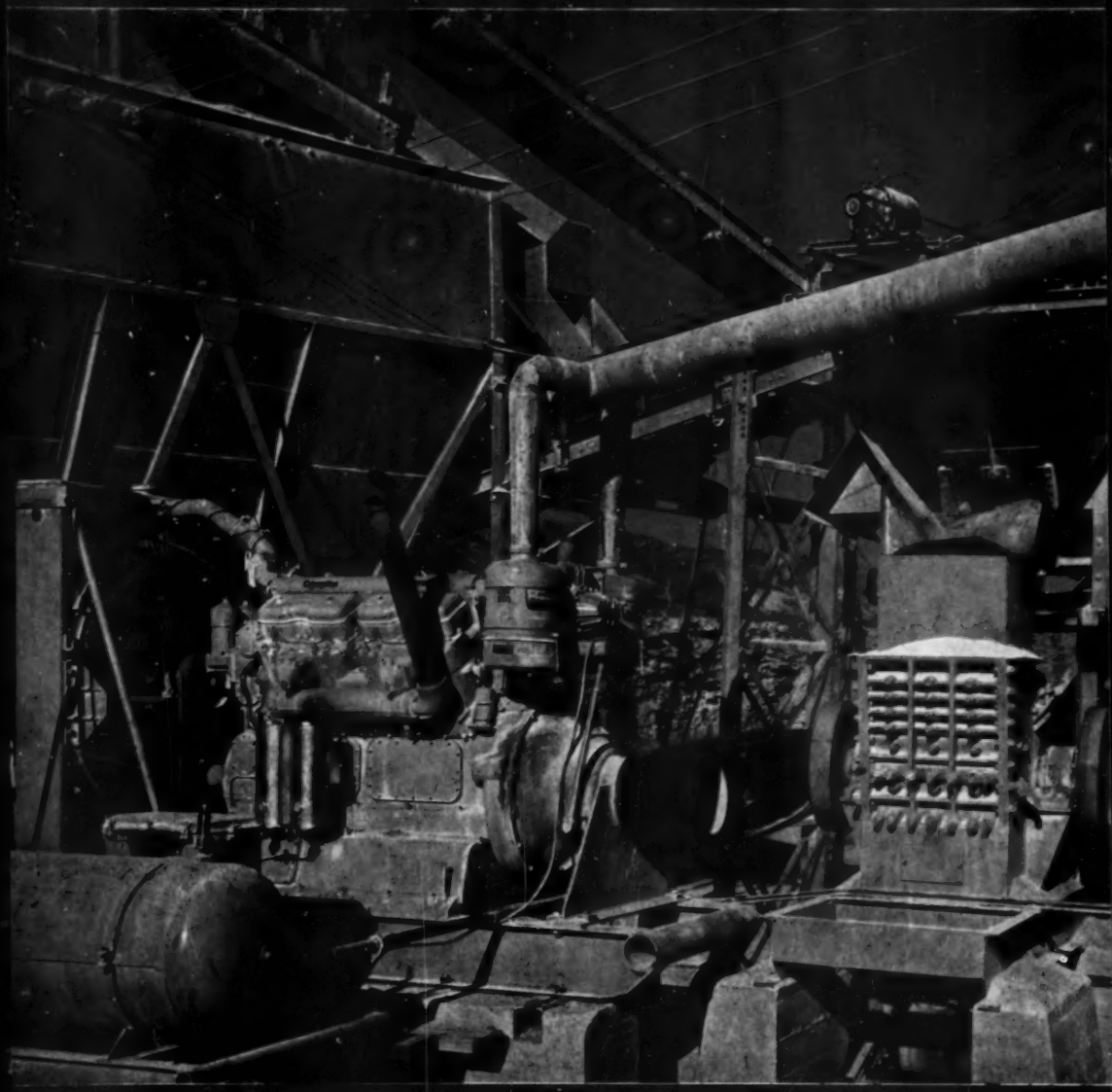
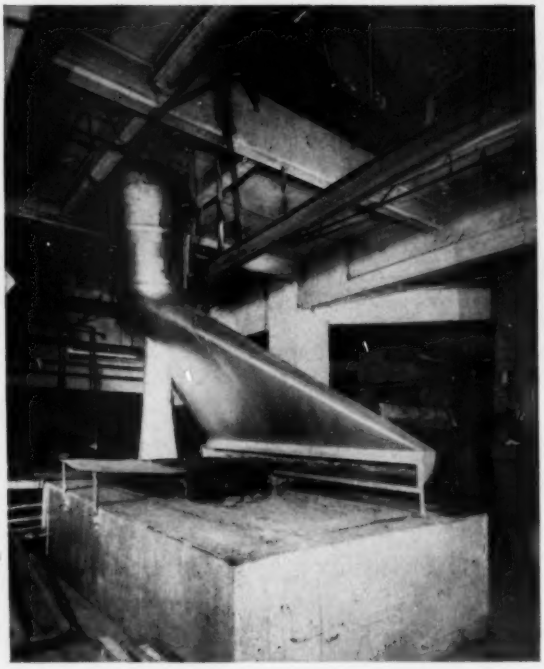
INDUSTRY AND POWER



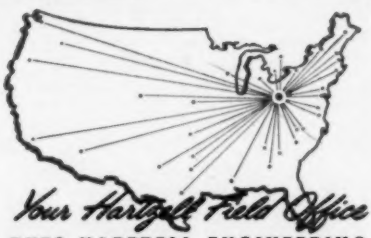
in *Cincinnati*... engineered movement makes a big difference



A battery of galvanizing tanks (one is shown at the right) in a Cincinnati plant was filling the air with noxious fumes and gases, even though the tanks were equipped with fan-powered canopies. Efficiency was reduced, production was slowed and the fumes became so bad that at times you couldn't even see across the room. Then the nearby Hartzell field engineer was called in. He studied the problem, calculated the need and prescribed a slot-type duct at the back of each tank, powered by a Hartzell ND28-6A-BDS duct fan. Immediately after the Hartzell installation the fume problem became a thing of the past.

Simple? Certainly. So was the original attempt, but *it* wasted money every hour it operated. In some cases, of course, a slot-type hood installation would be unsatisfactory; if friction loss is not calculated correctly, fumes will escape; if *both* air volume and speed are not close to the ideal, results will be bad. But you don't need to worry about these problems when you call in your nearby Hartzell field engineer. His experience, backed by the home office engineering laboratories, can help you *know* you'll get the *right* fan or blower and the *right* installation to give you the results you want.

The installation described above was handled by the Hartzell Field Office at 2712 Erie Avenue, Cincinnati 8, Ohio. Telephone East 4463



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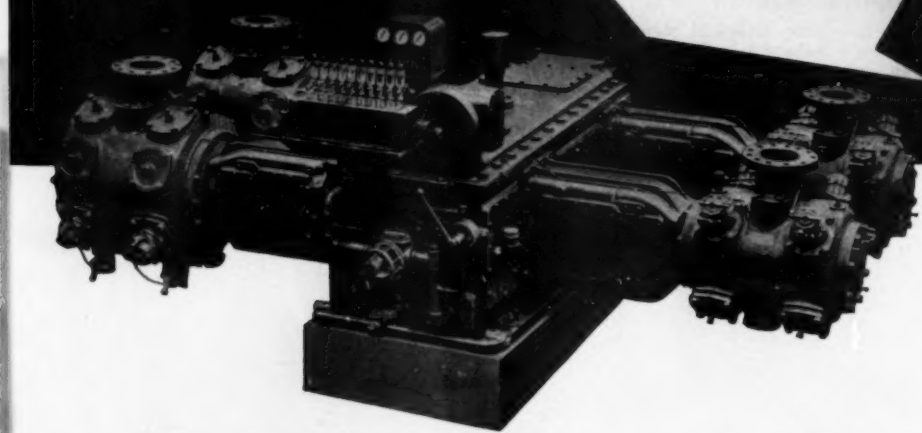

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Obtain *all* the facts today on the complete Clark Balanced/Opposed Compressor line available in 2, 4 and 6 cylinder sizes; 8, 14 and 17" stroke; 150-4500 bhp. Request Bulletin 118.

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- *Operated with any kind of drive.*

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Edited specifically for executives and engineers responsible for the selection, installation, operation & maintenance of equipment required for Engineered Plant Services*

INDUSTRY AND POWER

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FEATURE ARTICLES

Modern System Moves 600 Ton of Coal per Hour ... 67
E. L. Blankenbeker, Heyl and Patterson, Inc., and C. B. Risler, Westinghouse Electric Corp.
Instruments to Fit the Job ... 71
Warren Walker Jr., Industry Engineer, Steel and Ceramics, Minneapolis-Honeywell Regulator Co.
Utilizing Waste Atomic Pile Heat ... 99
Bearings . . . . Lubrication with Grease ... 100
Thomas Trail
Modern Zeolites Provide Higher Exchange Capacity ... 103
S. F. Alling, Vice President, Hungerford & Terry, Inc.
Centrifugal Pumps . . . . Types and Applications of Impellers — Part 4 ... 105
Igor J. Karassik and Roy Carter, Application Engineers, Worthington Pump & Machinery Corp.

SPECIAL REPORT

Packaged Electrical Distribution Equipment — Introduction ... 75
A. B. White, Associate Editor
Know Your Load ... 76
Know Your Supply ... 76
Load Area Size ... 77
Choice of Primary Voltage ... 78
Selection of Secondary Voltage ... 79
Location ... 80
Choice of Primary Circuits ... 81
Secondary Load Circuits ... 84
Transformers ... 86
Primary Substation Switchgear ... 87
Incoming Line Switchgear ... 88
Secondary Switchgear Variations ... 89
Load Center Switchgear ... 90
Grounding the System ... 95
Miscellaneous Units and Controls ... 96
Acknowledgments and Summary ... 98

DEPARTMENTS

Acorns of Science ... 6
New Equipment and Developments ... 8
New Bulletins and Catalogs ... 24
Credit for Cover Illustration—Caterpillar Tractor Co. ... 99
Materials for Engineered Plant Services ... 110
Practical Ideas, Kinks, How To's ... 112
Handbook for Engineered Plant Services ... 113
Spot News of Industry ... 118
News of Men and Companies ... 124
Book Reviews ... 128
Meetings and Exhibitions ... 128
Readers' Guide to Advertised Products ... 133
Available Reprints ... 177
Classified Advertising ... 177
Advertisers' Index ... 178

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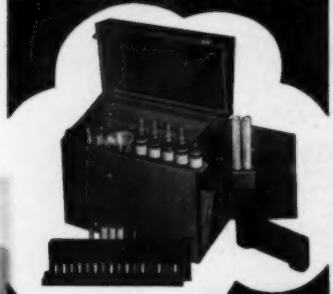
WITH PROPER pH AND PHOSPHATE CONTROL



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Acorns of science

Developments not yet available, but of interest to those responsible for Engineered Plant Services

Spray Casting

● Even large, complex parts of high melting point metal can be formed by using the metal spraying process to deposit material on a core of the desired shape, then sintering deposit to form dense, strong parts. M.I.T. scientists, in a Navy Bureau of Ordnance project, uncovered information on the method by which sprayed metal deposits are formed, used it to develop the metal forming process. Parts difficult or impossible to shape by powder, metallurgy, precision casting and die forging can be fabricated.

Higher Temperatures for Plastics

● Remember when a motor was overheated if too hot to touch? Now, insulating materials and plastics withstand much higher temperatures efficiently. Adding to the list, U. S. Rubber Co. has a new laminating resin for temperatures to 500 F, with physical and forming properties similar to other polyesters. It owes its heat resistance to the chemical, triallyl cyanurate. It is now being tried in high speed aircraft, guided missiles.

Storing Energy

● Believed to be the world's largest single flywheel motor generator set with a flywheel weighing 91½ ton, equipment being built for a new 72 in. steel slabbing mill will handle high peak loads encountered. The set will be powered by a 9000 hp motor built by General Electric Co.

Sulfur from Waste Gas

● Additional supplies of currently scarce sulfur may be recovered from waste gases given off in petroleum refining and other manufacturing processes. Recovery, by a recently patented process, will not only help ease the shortage but will help reduce air pollution. The petroleum industry plans to increase the nation's supply of the critical material by 190,000 ton a year.

Seal for Electrolytic Tanks

● Patent No. 2,579,234, "Vacuum Seal for Florine Generating System", describes a seal for electrolytic gas generating equipment using an inert hydraulic liquid with an associated reservoir of inert gas. A pressure and liquid level balance is maintained under normal operating conditions, but introduction of the inert gas breaks the partial vacuum created by too rapid withdrawal of the electrolytic gas, or by similar malfunctioning.

Thin Steel

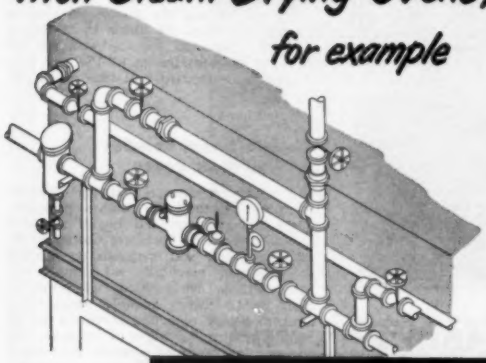
● Developed by Armco Steel Corp., steel with a thickness equal to one-tenth the diameter of human hair will be used in a secret government electronic device. Sounds like surface finish would be important here.

Protection from Corrosion

● Recent studies at the National Bureau of Standards provide a better understanding of the corrosion process and, consequently methods for prohibiting it. One result was determination of optimum protective potential on a firm scientific basis at −0.77 v when referred to a saturated calomel electrode. This approximately corresponds to the generally accepted value of −0.85 v referred to a copper-copper sulfate electrode, but eliminates uncertainties of RI drop.

Are Your Pressure Regulators Doing As Well?

...on Steam Drying Ovens, for example



THE INSTALLATION

In steam supply line to battery of 2 drying ovens at Ferro Chemical Corporation, Bedford, Ohio. Ovens individually controlled by thermostatic valves.

THE HISTORY

Specifications called for a valve to reduce initial steam pressure of 70 psi to 13 psi, and to maintain reduced pressure automatically without significant fluctuation whether one, or both, or neither oven is operated. Ovens to be operated at same or different temperatures, depending on process requirements.

Specifications were met with one No. 960 Crane Pressure Regulator, properly selected for capacity, and installed with adequate drainage of condensate.

In service now more than 5 years without interruption, Crane Pressure Regulator is giving complete satisfaction. Working like new; maintenance cost to date: zero. Remarkably simple to adjust.

VALVE SERVICE RATINGS

SUITABILITY:	Does everything claimed for it
MAINTENANCE COST:	None; working like new
CORROSION-RESISTANCE:	Steam only - corrosion no problem
SERVICE LIFE:	In 5 years; no sign of wear
OPERATING RESULTS:	No fluctuation of oven heat
PRICE:	Good buy
AVAILABILITY:	Regular Crane item

THE VALVE

Crane No. 960 Brass Pressure Regulator reduces 250-Pound steam or air inlet pressure up to 80%. Available for operation at any of 4 pre-set ranges within 1 to 200 pounds outlet pressure. Adjusts easily within any set operating range. All wearing parts renewable; virtually never wears out. See your Crane Catalog or Crane Representative.

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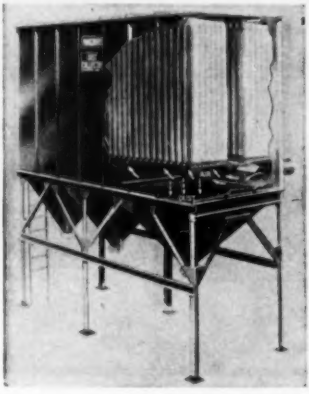
New equipment and developments

Highlights of new products by leading manufacturers

Each new product item has a key number for your convenience in asking for additional, detailed information. Insert key number on return post card on page 131

1—Dust collected by cloth bags

Pangborn Corp. offers a cloth-bag collector for dusts such as carbon black, cork, fine wood, graphite, pigments, lime, lamp black, soap, fine tobacco, metal oxides and other dusts with similar characteristics. These collectors range from 5 to 40 ft long; contain 1360 to 10,880 sq ft of filter cloth; employ from one to six hoppers; and are supplied with the appropriate structural supports to furnish the type of disposal desired—wheelbarrow, car, truck, etc. When the equipment is in operation, dust-laden air enters the collector at a point just under



the grid floor. The air loses velocity and the heavier particles fall immediately into hoppers. The air then rises through the grid into filter bags sealed over each grid opening. All air passes through the bags on its way to the air outlet at the top of the collector. Dust captured in the bags is removed by shutting down the exhauster and turning on the shaker motor. Dust falls through the grid openings into hoppers. Opening a valve at the bottom of the hopper discharges dust from the collector for reclamation or disposal.

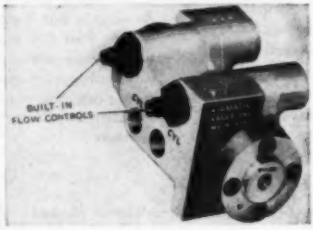
2—Miniature control unit interchangeable

A miniature all-electronic process control unit known as the Autronic Controller is announced by The Swartwout Co. Featuring complete electronic operation, it has no moving parts, slide wires or boosters to initiate control action. Response is instantaneous, and there is no significant limitation on distance of transmission. The controller incorporates functions of proportion, reset and rate-time (derivative) integrally, with the proportional band always in operation. Adjustments for the proportional band, reset rate, and rate-time (derivative) are readily accessible and easily made with a pocket screwdriver. Standard proportional band adjustment is from 2 to 200 per cent, with wider ranges available. Reset adjustment covers the range from 0.03 to 20 repeats per min. Reset can be turned off if not

required. Rate-time (derivative) is graduated from 0.05 to 8 min with an "Off" position integral to the scale. The input is the 0.0 to 0.5 v a-c signal direct from the primary element. Input voltage is continuously modulated and converted to d-c for final control element operation. Unit is of the plug-in type making it interchangeable, and one standard control can serve as replacement for any other controller regardless of variable being controlled.

3—Air valve controls piston reaction

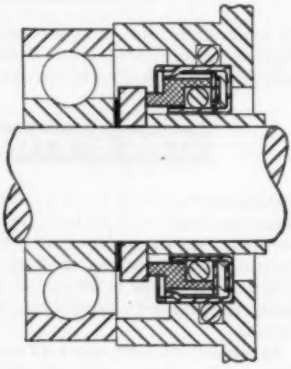
Model MV-4-375 air control valve, which may be used with pilot valves to provide automatic and semi-automatic operations, sequence of operations, and remote control paneling, is introduced by Airmatic Valve, Inc. Said to eliminate insufficient pressure or excessive dwell in air cylinders of 6 in. dia or more, this pilot operated, 4-way master valve is suited where larger bore air cylinders are used in certain assembly



methods such as crimping and staking. It is used in conjunction with two auxiliary bleeder valves. Momentary operation of either of the bleeder valves causes a shift in the valve spool, resulting in movement of the double acting cylinder piston. After the piston has reached the end of its stroke, a predetermined amount of pressure builds up which opens the sequence valve. Air is admitted to the pilot side of the pilot-operated bleeder valve, thus opening this valve and causing the master valve spool to shift and return the piston to its starting position. Designed for use with air, oil or water at pressures up to 150 psi, it is available for standard pipe sizes of ¼, ⅜, ½ and ¾ in.

4—Shaft seal handles liquids or gases

A positive mechanical shaft seal designed to meet the need for higher pressures, higher temperatures and higher rpm has been developed by Cartriseal Corp. In construction of the seal, materials are selected to withstand practically all liquids and gases without deterioration. Simplicity in basic design makes possible variation to meet most any operating condition or assembly problem. Features of hydraulic balance and low unit load pressures are claimed to insure longer life. Typical applications



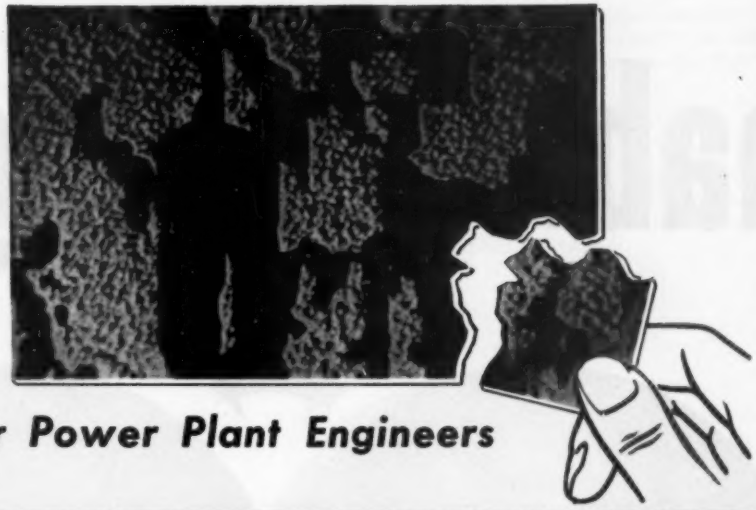
include washing machines, water, oil and fuel pumps, hydraulic transmissions, generators, gas blowers and other equipment requiring a positive mechanical seal.

5—Lubricator operated by line pressure

Elliott Co. has announced a sight-feed lubricator for lubrication of tube cleaners and other air or steam powered tools. Once set, this lubricator requires no adjustment or turning on or off. It is actuated entirely by pressure of the operating air or steam; not by flow. As long as pressure is supplied, oil is accurately metered into the operating hose. When operating pressure is off, oil flow is completely shut off. Rate of

(Continued on page 12)

JIG-SAW PUZZLE



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NEW DATA ON SCALE IN HIGH PRESSURE BOILERS

Reprints of "Experimental Studies of Boiler Scale at 2,500 p.s.i.," a paper presented at the 1950 Water Conference of the Engineer's Society of Western Pennsylvania, are available free upon request to Nalco. Article includes numerous photos of scale formations on test boiler tubes, and charts showing results of various water treatment methods.

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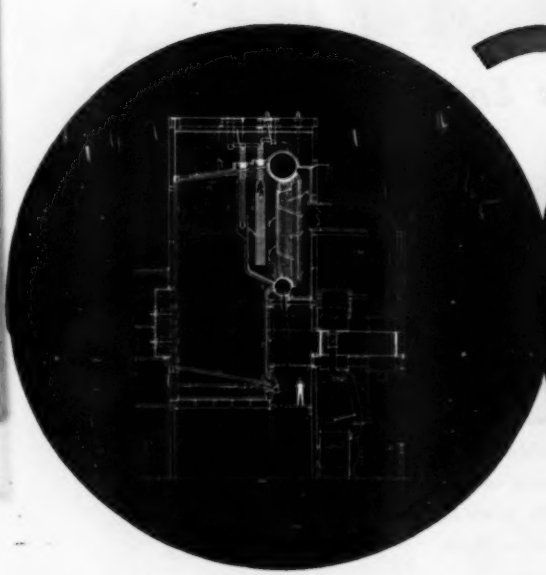
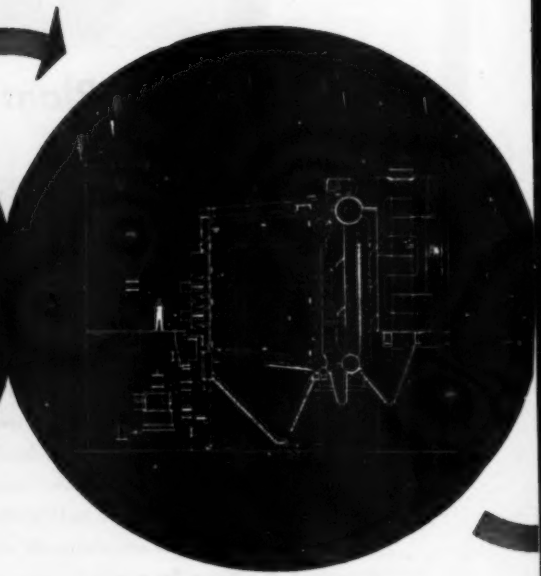
Are VU Boilers habit forming?



VU-50 Boiler fired with oil. The capacity of the unit shown is 350,000 lb of steam per hour; operating pressure—920 psi; total steam temperature—905 F.



VU-50 Boiler fired with pulverized coal. The capacity of the unit shown is 150,000 lb of steam per hour; operating pressure—625 psi; total steam temperature—760 F.

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS, ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

The record shows that they are. More than 100 companies . . . large and small . . . throughout this country and abroad . . . have ordered VU units more than once. Nearly half of these have ordered more than twice. Some as many as 5 or 6 times.

Considered in light of the fact that Vertical-Unit Boilers have never been—nor are likely to be—the cheapest you can buy, such a record becomes even more significant.

Here are just a few examples of the many industries that appear to have formed the VU habit.

A Steel Company now has a total of eleven VU Units in three different plants. Starting with an initial installation of three units in 1940, it has reordered twice; three units for a second plant in 1946 and five units for a third plant in 1950.

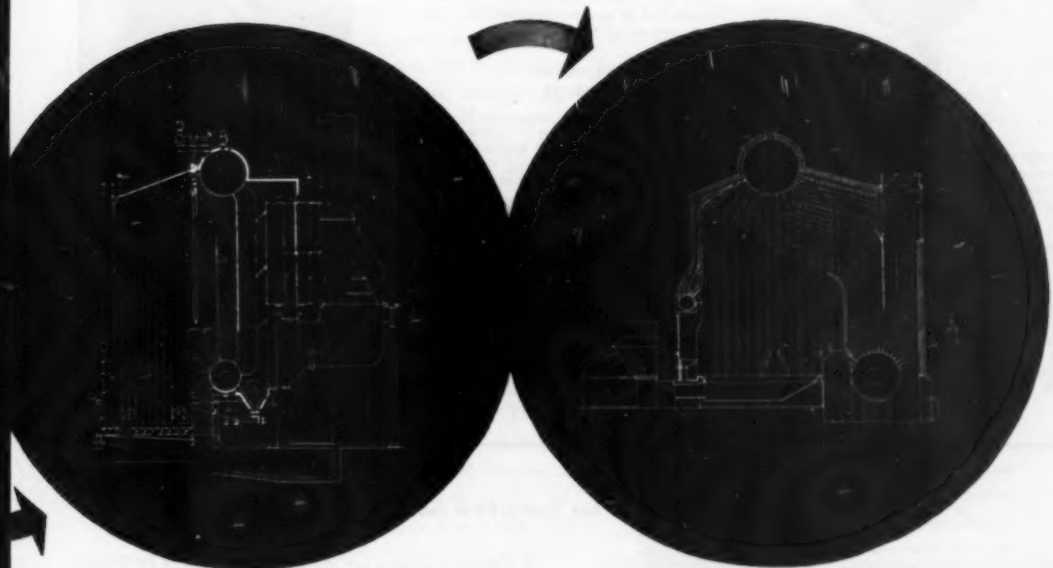
An Electric Utility Company started using the VU in 1944 when two units were installed at one of their power stations. When the capacity of this station was increased in 1948 two more units were installed. In 1947 this company ordered two more units for another of its stations.

An Oil Company ordered its first VU in 1937, its second in 1938. In 1942 another VU was installed and still another in 1944.

An Aluminum Company is another consistent buyer of VU Units. Since installing its first VU in 1940, it has reordered four times, and now has five C-E Vertical-Unit Boilers in service.

* * *

Just a small sample to be sure, but one that can be repeated over and over for other industries and other companies . . . companies that have ordered and reordered VU Boilers . . . companies that have the "VU habit" and find it highly profitable. B-511



VU-50 Boiler as adapted for firing bagasse on a C-E Spreader Stoker. The capacity of the unit shown is 75,000 lb of steam per hour; operating pressure—160 psi; total temperature—530 F.

VU-10 Boiler fired with C-E Skelly Stoker. VU-10 Boilers range in capacity from 10,000 to 60,000 lb of steam per hour. They may be fired by underfeed, spreader or chain grate stokers or by oil or gas.

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

New equipment and developments

(Continued from page 8)

oil flow is controlled by a knurled cap on top of the lubricator. A knurled filler plug can be removed and reseated by hand. Since its operation is based on pressure, not flow, a shut-off valve in the operating line must

always precede the lubricator, and it is therefore unsuited for use with tools which are controlled at the motor. It is supplied in 1 pt and 2 qt capacities.

6—Coating prevents corrosion

Steelcote Stainless Steel Coating, for application by brush or spray gun to all metal surfaces, is announced by Steelcote Mfg. Co. Drying to handle in 1 hr and for regular use in 3 to 4 hrs, the coating is the color of unpolished stainless steel. It protects against rust, corrosion and other types of deterioration caused by salt air and water, industrial atmospheres, alkalis, oils, greases, most strong acids, heat, cold and sunlight. The film is odorless, non-inflammable, and will take fungus treatments.

8—Butterfly valves for high pressures

W. S. Rockwell Co. has developed a line of rubber-lined butterfly valves for operation and tight shut-off at high pressures. They

range in pipe sizes from 4 to 36 in. and larger. Purpose of rubber liners is to insure tight closure, particularly at higher temperatures. The valves are generally of cast iron or cast steel with a steel blade, with special blades available for corrosive conditions. Valves can be equipped for automatic, remote or manual control.

9—Cleaner removes carbon deposits

Magnus Chemical Co. announces Magnus 751, a cleaner for removal of carbonaceous deposits from the tubes of fuel oil heaters without need for dismantling the equipment. In the cleaning operation, all valves of the exchanger are closed and a water solution of the cleaner is circulated through the tubes from inlet to outlet by means of a pump installed in a temporary tank. The exchanger is heated to a uniform temperature of 140 F during the cleaning. A screen in the discharge or return line retains loosened carbon deposits. When the solution is thickened by removed carbon, it is replaced by a fresh solution and the direction of flow reversed. The second solution is left in the tubes for several hours after circulation, after which the system is flushed with water and left ready for operation.

10—Sight-flow indicator uses O-ring seals

Introduction of the Trin-Vue sight flow indicator has been announced by Trinity Equipment Corp. Two windows located on opposite sides permit maximum visibility and examination of the fluid. The windows

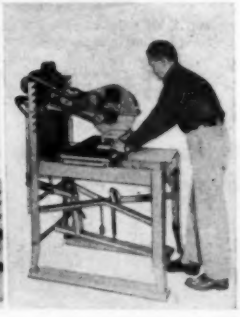
are sealed in the unit by use of O-ring gaskets and Truarc retaining rings. This construction permits a tight positive seal, made tighter the greater the pressure or vacuum applied. Pressure on the glass is equally distributed at all times. A perfect seal at

(Continued on page 16)

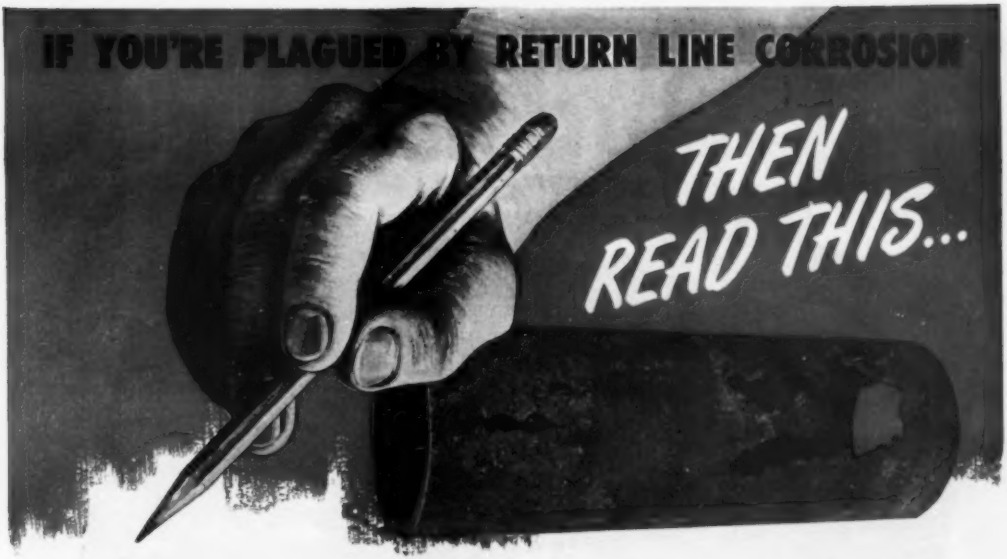
TO REQUEST ADDITIONAL FREE DATA

Each paragraph in this section is numbered —beginning with number 1. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out and mail this card. Our Reader Service Department will handle your request promptly

7—Masonry saw has convertible feature



A convertible masonry saw is being manufactured by the Clipper Mfg. Co., developed for use in both the building and industrial fields. The convertible feature makes it possible for owners of the Model HD masonry saws to convert their present equipment into a concrete or track saw. At any time the cutting head of this saw, which may be used as either a wet saw as shown in the right hand illustration, or as a dry saw, can be placed on the convertible 4-wheeled cart. The equipment is then ready for sawing concrete or asphalt patches or trenches in building floors, drives and walks. Through this conversion it is possible to switch from sawing glazed tile, concrete block and fire brick to sewer, water or gas lines and floor patches in a matter of minutes. Fractures from jack hammer operations are now confined within the sawed removal lines, and spalling of edges is eliminated. By placing the convertible cart on tracks as shown, a fourth use is accomplished. Stone slabs, Transite sheets, pre-cast stone, large refractories, plywood and masonite can be placed under the elevated tracks and sawed with the track saw.



As an engineer responsible for efficient, economical plant operation, you know only too well that corrosion of steam and condensate lines can send costs skyrocketing through pipe replacement, interrupted production, and increased labor and maintenance. Perhaps you, like many other engineers, have tried stop-gap methods to check the problem only to find them partially effective or far too costly.

Realizing the importance of this major industrial problem, Betz Laboratories has developed its patented filming amine treatment. Here, at last, is a simple, inexpensive, and practically 100% effective method of eliminating this costly and production-disrupting headache.

For example, a linoleum company, operating at 150 psi and producing 300,000 pounds of steam per day, employed sodium zeolite softening for a high bicarbonate raw water. The carbon dioxide content of the steam averaged 40 ppm. Continued maintenance was required due to failure of condensate lines from the steam kettles and unit heaters. After the filming amine treatment was applied, maintenance records showed an annual saving of approximately $8,000.00! And, a large part of this saving was obtained by eliminating weekend over-time work on pipe replacements.

Why not take the first step toward ridding your plant of corrosion *now?* Call in a Betz Engineer. Ask him to show you how Betz *Specialized* Water Conditioning Service can help you . . . quickly . . . economically . . . effectively. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

See for yourself how Betz filming amine treatment eliminates return line corrosion and reduces operating costs. Send for Technical Bulletin No. 124.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

"HOW WE USING COAL

Louis G. Notte,
Chief Power Engineer,
Little Falls Laundry,
Little Falls, N. J.

To this great modern plant in Little Falls, N. J., 500 employees come every day to take care of the laundry for an estimated 100,000 people. And from this plant 100 trucks travel to customers spread across a 5,000 square-mile area! The laundry can be called completely self-sufficient. It depends on coal to provide all electric power and lights—heat for all buildings—steam for hydraulically-operated machines—steam for pressers and dryers.

If you're running your own steam plant, here are a few down-to-earth facts you don't want to miss!

COAL in most places, is today's most economical fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

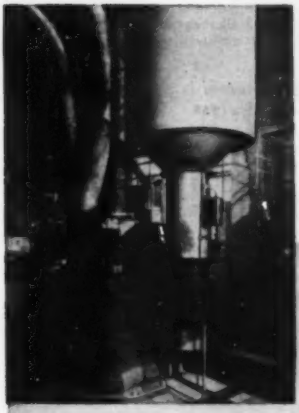
COAL is the safest fuel to store and use.

COAL is the fuel that American industry can count on more and more—for with modern combustion-and-handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

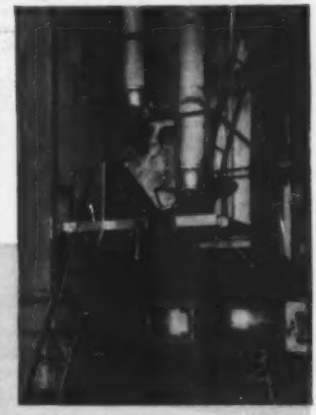
SAVE $20,000 A YEAR—INSTEAD OF OIL"

(ACTUAL CASE HISTORY OF THE LITTLE FALLS LAUNDRY, LITTLE FALLS, N.J.)

"Our laundry is one of the largest in the country," says Chief Power Plant Engineer Notte, "and, we think, one of the most progressive. Our company insists on superior performance at lowest possible cost all along the line. That's exactly why we depend on coal-fired equipment. From coal we get the daily amount of BTU's we need at a cost of $200—to get the same BTU's from oil would cost $280. We can change to oil on less than a day's notice —but so far we've *never* done it. Coal does a great job—cheaper."



This is the company's up-to-date pulverizer from which the ground coal is blown into the boiler. Before this final operation, the laundry employs a steel-slatted conveyor belt to feed a precrusher. From there, power-driven bucket-conveyors carry the coal to the 100-ton storage hopper which feeds the pulverizer. *Modern automatic coal devices of all kinds slash labor costs—make coal's basic economy even greater.*



This is a section of the laundry's modern coal-fired boiler installation. With modern equipment like this it is possible to add anywhere from 10% to 40% to the power derived from the same amount of coal in years past. Actually with coal-fired plants of up-to-date design many companies have brought over-all boiler efficiency up to 85% or more.

● Plants that use coal are in an enviable position —at the present *and* for the future. *For they are more certain than the users of other fuels of a dependable fuel supply—at stable prices.* The reasons are compelling. Of America's total fuel reserves, 92% is coal: Even today, oil is *imported* while this country can and does *export* coal. In addition—this country's mines are the most highly mechanized and efficient in the world.

To get *all* the great economy that coal can deliver—to find out how much more efficient and dependable a job coal and the very latest coal-fired equipment can do—call in a competent consulting engineer. He'll recommend the right equipment for your specific needs. Then you'll see exactly why coal *on a performance basis, on a dollars-and-cents basis* . . . is your best fuel buy, by far!

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

New equipment and developments

(Continued from page 12)

3 psi continues at higher pressures up to 2000 psi. Other features include light weight, tamperproof construction and welded design. Indicators are fabricated of extra heavy wall forged tubing of several materials. Sizes range from ½ to 4 in.

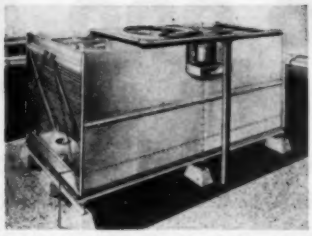
11—Panels handle up to 40 circuits

The Square D Co. has announced an expansion of its NMO "Plug-in" Panelette line. These lighting panelettes are now available with either lugs or circuit breaker mains from 2 to 40 circuits for use on a-c lighting and appliance branch circuit applications. Four standard basic devices of 12, 20, 28 and 40 circuit combinations are available, permitting selection of equip-

ment to meet job requirements. They incorporate thermal-magnetic "Plug-in" circuit breaker units (rated 15, 20, 30, 40 or 50 amp) mounted on cylindrical bus bars. The circuit breaker units are interchangeable with those of the MO-12 and MO-20 load centers. The units bear UL approval and label and are available for 3 wire single phase or 4 wire three phase systems.

12—Water cooling tower features low height

Marley Co. announces their Double-Flow Aquatower, a water cooling tower for use wherever intermediate capacities of cold water are required. Cooling towers of this range are widely used in the power, petroleum, gas, chemical processing, food processing and metalworking industries, and wherever air conditioning and refrigeration are used. Features of the tower are: low height compared to cooling capacity; low pumping head and required fan hp for any given capacity and design performance; patented Double-Flow principle, with one fan utilizing air from two completely open sides; tower weight evenly distributed over a wide area; and all parts readily ac-



cessible. The tower comes in seven standard sizes, starting with a 50 ton unit. It is available in steel or wood with asbestos cement board casing.

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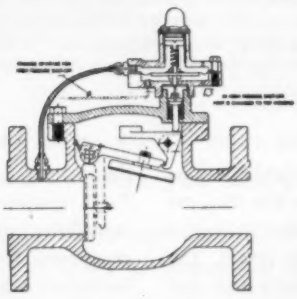
13—Valves provide safety factor

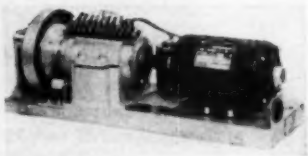
Sentry low-pressure and high-pressure shut-off valves, manufactured by the McRae Valve Corp., have been improved to provide maximum protection against reduced or excessive flow through all types of pressure lines in plants and public buildings. Valves can be set to close within ½ oz of pre-determined dangerously low or high



pressures. Dual spring control makes this possible. They cannot be closed prematurely, but once reduced or excessive pressure causes closing, they form a positive line seal until reset by hand. The diaphragm control section of the valves is a separate unit, not in the line stream. Destruction of diaphragm control by any method will cause the valves to close instantly. Available in 1 to 6 in. sizes, in bronze or semi-steel.

14—Device indicates shaft position

A precision shaft-position indicating system which rapidly and accurately detects the angular position of a rotating shaft and converts the resulting indications to a digital representation has been developed by Engineering Research Associates, Inc. Designated as the Shaft-Monitor, the device consists of two major components, an electromechanical locator unit which couples to the reference shaft and an electronic converter unit. The device utilizes a simple magnetic recording mechanism to indicate on command the position of a reference shaft. Accurate to plus or minus 0.09 deg, measurements may be routed to a convenient remote location and displayed as visual indications in digital form, transferred to magnetic tape, punched tape, or punched cards for future analysis, or used



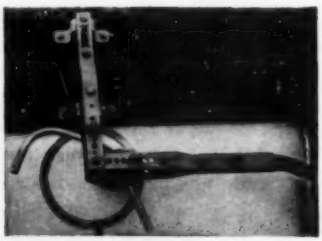
to perform desired control functions. Numerous design options are available providing flexibility of system application.

15—Enamel is odorless

Wilbur & Williams Co. announces odorless industrial paints, which have no odor during the painting operation. They have the paint qualities required by the food processing industries, such as resistance to steam cleaning, dampness, butter fat and greases. Odorless Dampcoat Enamel is now available in gloss, eggshell or flat finish, and provides a versatile maintenance system for food plants, creameries, dairies, hotels, restaurants, hospitals and institutions where lack of paint odor, high washability and resistance to food greases, fat, lactic acid and other semi-corrosive conditions pose a maintenance problem. It is fast drying, non-yellowing, and can be applied over damp or dry, painted or unpainted wood, new plaster or metal.

16—Bender handles thin wall conduit

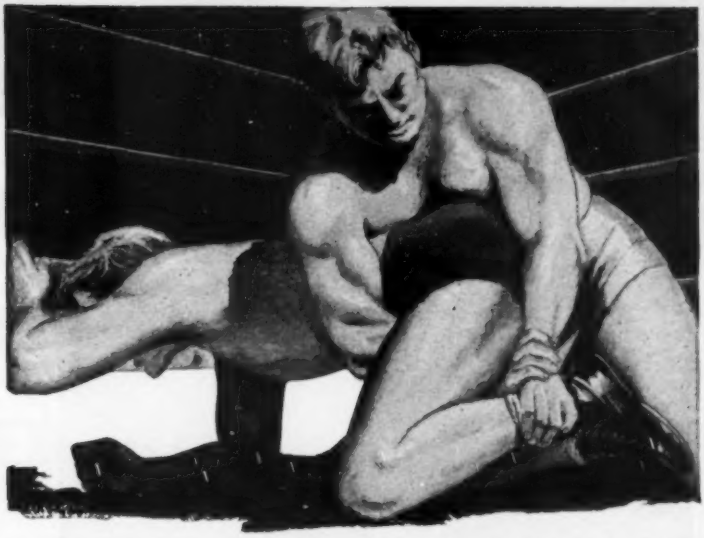
A bending die that adapts the Hossfeld No. 2 Universal iron bender to bending of thin wall electrical metal conduit has been announced by the Hossfeld Mfg. Co. With



these dies, the bender makes round, smooth, wrinkle-free bends of all standard sizes of thin wall conduit from ½ to 2 in. Full 90 deg bends in conduits of 1¼ in. size or smaller are made by direct leverage with one of the hand levers. A compound leverage principle makes bending of 1½ and 2 in. conduit easy. Conduit is supported from the outside against flattening and wrinkling, no

(Continued on page 20)

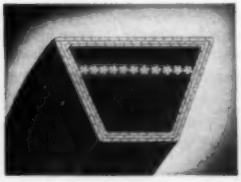
Dayton Cog-Belts*
bend better...*are* better!



Dayton raw-edge Cog-Belts are the *only* V-Belts scientifically designed to bend as easily as your finger. The cogs "close up"—take up the compression as the belt goes around the pulley. Result: Less strain . . . cooler running . . . smaller pulleys . . . 40% more horsepower . . . much longer belt life.

See HOW MUCH better Cog Belts are!

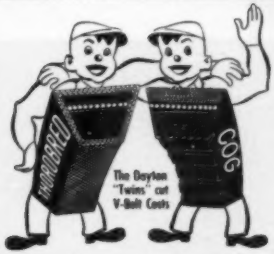
This V-Belt drive transmits the power from two diesel engines to a dredge pump, which delivers 100 cubic yards of sand and gravel per hour. The former drive used 16 ordinary V-Belts which were capable of handling 140 constant horsepower. But the dredging company wanted to step this up to 188 horsepower, to meet new production requirements. Trouble was, the increased load meant adding more belts—*and there was no room for pulleys with more grooves!* The Dayton Distributor simply put Cog-Belts on the drive. Now the same number of belts carry the increased load—and the dredge's space problem is solved. Whether *your* drive problem is *space, cost,* or *longer life,* it will pay you to look into the advantages of the Dayton Cog-Belt.



FOR REGULAR DRIVES . . . THE DAYTON THOROBRED V-BELT IS TOPS!

The Dayton Thorobred V-Belt is the V-Belt for standard drives. Its patented, three-prime-section design, containing high-tenacity rayon cords, and its durable double wrap, result in exceptionally long life. The Dayton Thorobred V-Belt has set completely new standards for long life and trouble-free service at minimum cost!

*T.M.



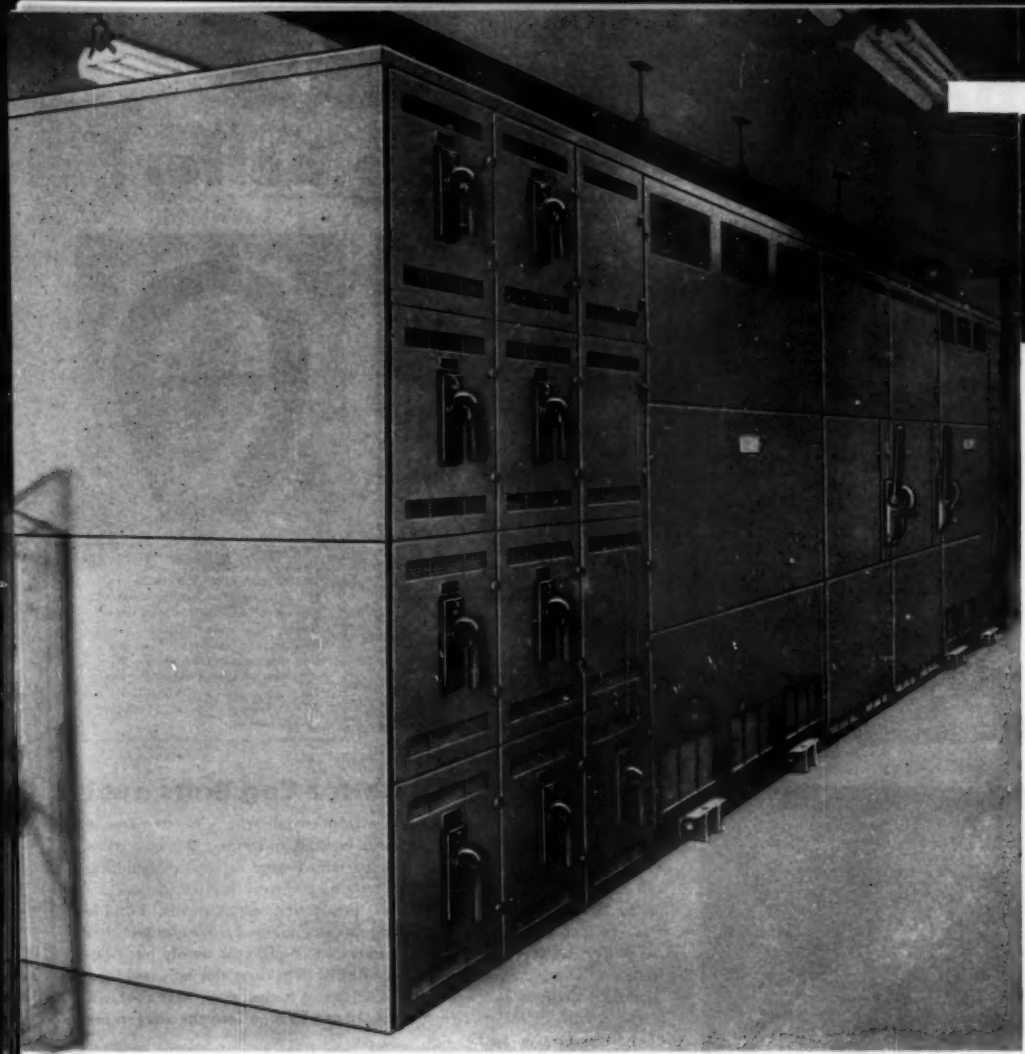
See "Belting" in the yellow pages of your local telephone directory for the Dayton V-Belt Distributor. Let him solve your drive problems!

Dayton Rubber

Since 1905

World's Largest Manufacturer of V-Belts

DAYTON RUBBER COMPANY • DAYTON 1, OHIO



Here is a typical I-T-E indoor Unit Substation with air cooled transformers. Substation arrangement puts primary load break interrupter switches *and* transformers in the center. As load grows, addition of low voltage switchgear to either end is simple and inexpensive.

Uniform appearance of the structure and symmetry of enclosing panels are consistent with the operating excellence of I-T-E switchgear.

Only at I-T-E is *all* of the unit substation enclosure designed, manufactured and assembled in the *same* plant of one division of the company. Quality control is consistently maintained and coordination is assured. Results are simplified installation and improved appearance for *your* plant.

There's an I-T-E Field Application Engineer near you to help you in planning for the future with sound engineering information about I-T-E Unit Substations. Call him today!

I-T-E

1 **REDUCED CONDUCTOR INVESTMENT AND MAINTENANCE**

I-T-E Unit Substations distribute low voltage a-c energy to the load with shorter bus or cable runs.

2 **LOWER COST OF LOW VOLTAGE METAL ENCLOSED SWITCHGEAR**

Reduced transformer sizes at load centers require lower interrupting capacity circuit breakers, with resulting savings in switchgear costs.

3 **SMALLER WORK AREA AFFECTED BY POWER INTERRUPTION**

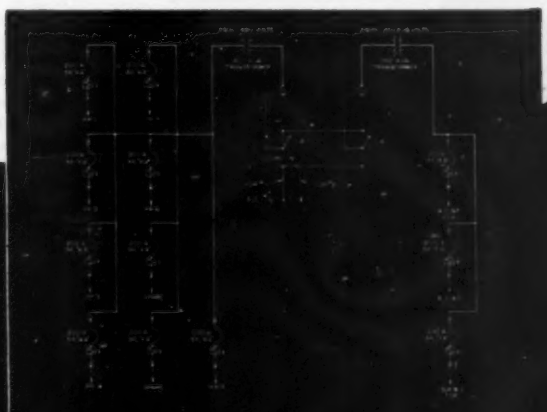
With individual I-T-E Unit Substations spotted at load centers, substations may be moved as load centers shift. Manufacturing processes in other sections of your plant are not affected — production is sectionalized.

4 **TIME SAVED AT INSTALLATION**

Piecemeal deliveries involve storing, assembling, testing. I-T-E substations are shipped to you as complete packages: factory engineered, assembled, tested before delivery. Time means money — save it!

5 **TIME AND MONEY SAVED IN YOUR ENGINEERING AND PURCHASING DEPARTMENTS**

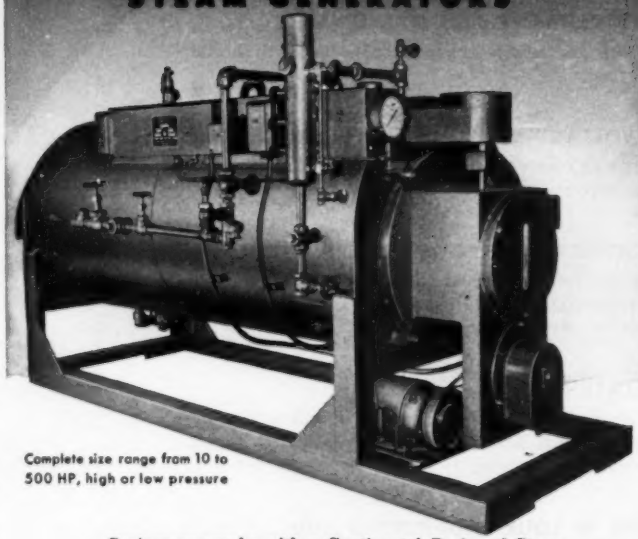
Reduce your engineering specifications to a simple, one-line diagram—all you need to secure a quotation, complete with physical arrangement drawings and specifications covering all components of the substation: primary switchgear, transformer, secondary switchgear.



Steam at low cost

Continental

PACKAGED
STEAM GENERATORS



Complete size range from 10 to 500 HP, high or low pressure

Savings you make with a Continental Packaged Steam Generator rapidly repay your initial investment. First, you save on installation. The unit is factory assembled and tested, ready to operate after simple service connections in your plant. Second, you save on fuel. The Continental operates with guaranteed efficiency of at least 80%. Independent tests prove the steam generated contains less than 1% moisture.

Of proven Scotch Marine design, this is a 2-pass boiler requiring far less refractory than ordinary 3- and 4-pass boilers. The fuel is burned in furnace entirely surrounded by water, and the gases pass spirally through 3" tubes, giving maximum heat transfer, low flue gas temperature, and high efficiency.

Third, you save on maintenance. Boiler front and back can be opened in 15-20 minutes, simplifying cleaning and servicing. Many users report these and other major savings with the Continental in heating and processing.

The unit is completely automatic and equipped with efficient burners for heavy oil, light oil, gas, or a combination.

May we send you literature that fully describes it? Call or write today.

BE

BOILER [illegible]

DISTRIBUTORS—PLEASE NOTE: A few choice territories are open. Request details on your company letterhead.

New equipment and developments

(Continued from page 16)

inside mandrel is needed. Other standard equipment for bending rod, bar, flat stock or angle iron may be added.

17—Catalytic process eliminates scale

The Sola Catalytic process for the treatment of industrial and potable water to eliminate rust and scale and reduce corrosion in boilers, tanks, and all types of water systems, has been announced by the Sola Catalytic Co. The catalytic action of the treatment does not change the chemical structure of the water in any way, but stops the formation of new scales and gradually removes all old existing scale. It also reduces corrosion to a great degree. Other benefits of the process described in the company's literature include elimination of odor of chlorination; elimination of the need for dosing and periodic analysis and control required when chemical softeners and de-scalers are used. Results are achieved, the company states, by catalytic process which creates a dispersion of the elements in the water that have an affinity for forming scale and corrosion. The apparatus is available in various models for any type and size of application.

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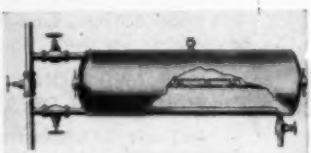


18—Heating cable prevents freezing

Thermwire, a flexible electric heating cable, has been introduced by Edwin L. Wiegand Co. The cable consists of a heavy gage nickel-chromium resistor wire with tough, abrasion-resistant insulating sheath. Equally useful around home or plant, it protects roofs, gutters and downspouts from accumulations of snow and ice; embedded in asphalt or concrete, it melts ice from doorways, steps, sidewalks, driveways or other pavements; prevents freezing of pipes; and provides a portable, pliable heat source to cope with other cold weather problems. It

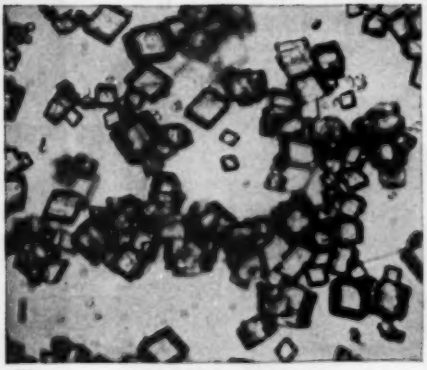
(Continued on page 150)

ALLIS-CHALMERS

No. 26 Series

ORGANIC SLUDGE DISPERSIVE

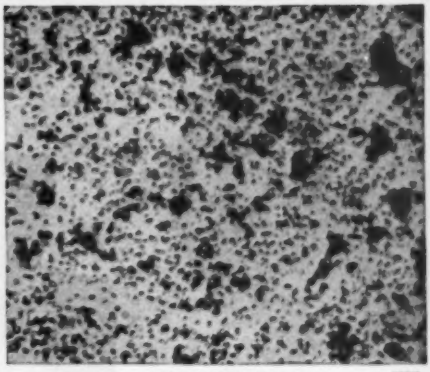
Controls Sludge-Scale



500X

UNTREATED

Note large crystal size



500X

TREATED

Inhibited crystal growth and dispersion keep sludge fluid

BOILER SLUDGE CAN FORM SCALE . . . because of its inherent tendency for adhering to heat transfer surfaces.

The dispersive property of Allis-Chalmers No. 26 Treatment prevents crystal growth and produces a fluid sludge, readily removed by blowdown.

To you, the engineer, this means cleaner boilers — boilers that seldom if ever require turbining or other forms of cleaning. No. 26 Treatment does not soften the water, but it can be mixed with softening chemicals (if desired) without reducing its effectiveness as a sludge conditioner. This simplifies its application and reduces your investment in feeding devices.

A COMPLETE, BRIEF discussion of the Allis-Chalmers No. 26 Series organic sludge treatment is available in our bulletin number 2807543. (Coupon below for your convenience.)

Allis-Chalmers A-5000
Milwaukee 1, Wis.

Gentlemen:
Please send me Bulletin 2807543.

Name _____

Title _____

Company _____

Address _____

City _____ State _____

ALLIS-CHALMERS AC

Water Conditioning

✓EQUIPMENT ✓CHEMICALS ✓SERVICE

BIRD & SON, inc.
BIRD PRODUCTS
Established 1795

very much pleased with

Bird & Son, one of the countries outstanding manufacturers of roofing and building materials, linoleum, shipping containers and other paper products, recently modernized their East Walpole power plant by installing a 175,000 lbs./hr. Riley single header hopper bottom pulverized coal-fired boiler unit and a 5000 K.W. generator.

Performance of the Riley boiler unit has been entirely satisfactory. Note comparison of guaranteed and actual results below.

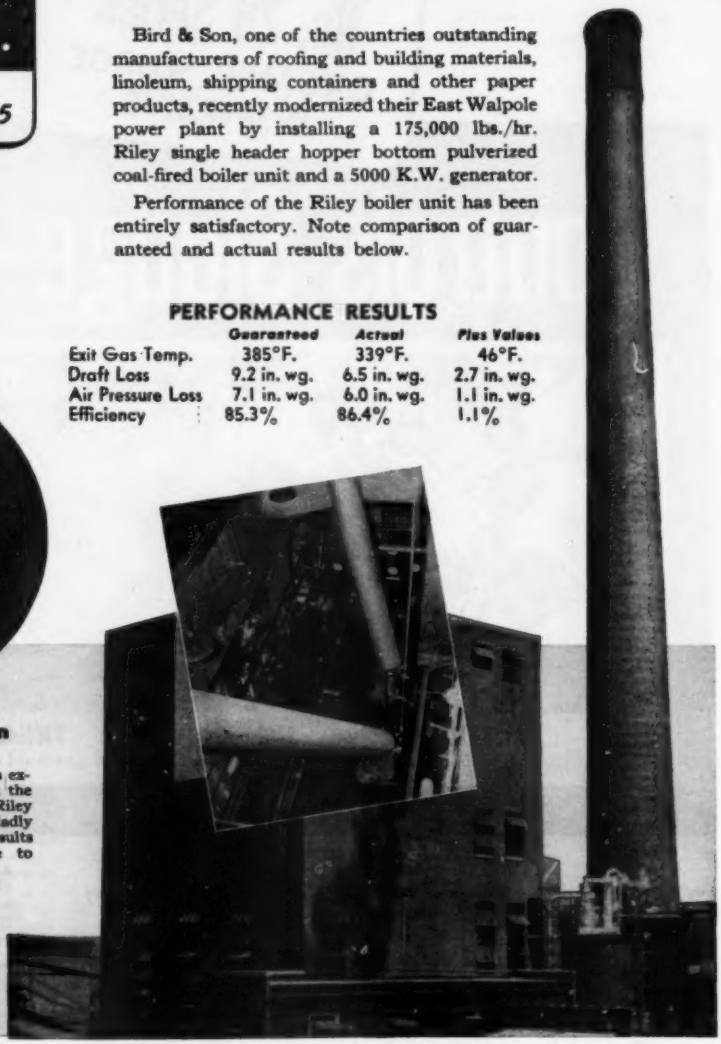
PERFORMANCE RESULTS

	Guaranteed	*Actual*	*Plus Values*
Exit Gas Temp.	385°F.	339°F.	46°F.
Draft Loss	9.2 in. wg.	6.5 in. wg.	2.7 in. wg.
Air Pressure Loss	7.1 in. wg.	6.0 in. wg.	1.1 in. wg.
Efficiency	85.3%	86.4%	1.1%

Robert C. Holman
Plant Engineer

Mr. Holman advises he is exceedingly well pleased with the performance of the new Riley unit. We are sure he will gladly tell you of the excellent results he obtained if you care to inquire.

BIRD & SON, INC.
New Power Plant
East Walpole, Mass.



TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
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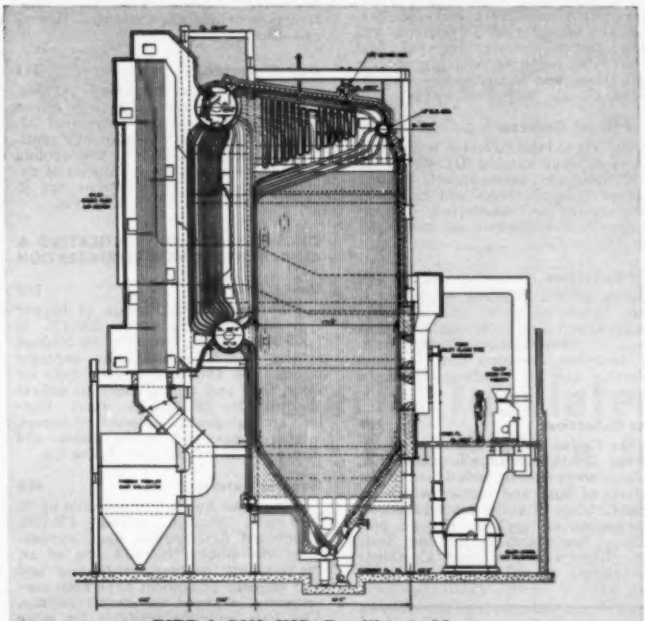
BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

results from their new Riley boiler unit

Riley Single Header Hopper Bottom Units save You money by

1. Reducing height of building required by as much as eight feet
2. Permitting installation of higher capacity unit in existing building
3. Eliminating cost of separate ash hopper
4. Eliminating cost of ash hopper seals and drip castings



BIRD & SON, INC., East Walpole, Mass.
RUST ENGINEERING Co., Engineers
175,000 lbs./hr. 710 lbs. pressure. 750°F. total Steam Temperature pulverized coal-fired single header hopper bottom Riley Units.

108 Riley Single Header Hopper Bottom Units Installed. Total Capacity 17,503,000 lbs. of steam per hour.

All of these well-known Companies have ordered Riley Single Header Hopper Bottom Units.

- *United States Steel Corp.—8 units
- *Esso Standard Oil Co.—5 units
- Chase Brass & Copper Co.
- South Carolina Gas & Electric Co.
- *Pratt & Whitney Co.—7 units
- Western Electric Co.—3 units
- *Monsanto Chemical Co.—2 units
- Norton Company
- Hanna Furnace—4 units
- *Celanese Corp. of America—6 units
- *Regel Textile Corp.—2 units
- American Viscose Co.
- Great Lakes Steel Corp.
- Cluett Peabody Co.
- *Waldorf Paper Products—2 units
- New Orleans Public Service Co.
- U. S. Rubber Co.—3 units
- Continental Can Co.
- Utah Power and Light Co.
- Gould Paper Co.—2 units
- South Carolina Public Serv. Auth.—2 units
- *Syracuse University—2 units
- *Dairyland Power Co-op.—3 units
- *Hooker Electro Chemical Co.—3 units
- Superior Water, Light & Power Co.
- Whippany Paperboard Co.—2 units
- Rayonier, Inc.
- U. S. Finishing Co.
- *Northern Paper Mills—2 units
- Cities Service Corp.
- Calumet & Hecla Consol. Min. Co.
- Otter Tail Power Co.
- Swift & Co.
- C. H. Masland & Sons
- Upper Mich. Power & Light Co.
- Los Angeles Water & Power Dept.
- Champion International Co.
- *Central Ohio Light & Power Co.—2 units

*These companies have placed repeat orders.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

New bulletins and catalogs

Literature on engineering products and developments

Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Insert key numbers on return post card found on page 131

AIR & DUST FILTERS & COLLECTORS

Dust Collector **200**

"Don't Let Dust Be Your Destiny", a 16-page booklet, should be of interest to engineers concerned with dust collection. Collector using wool felt as the filter medium is fully described, including principles of operation and engineering data. Numerous case histories are described and fully illustrated. Pulverizing Machinery Co.

Tubular Collector **201**

Tubular collector is featured in illustrated 20-page catalog 601. Fly ash control, efficiencies and dust collection requirements are discussed. Principles of operation, dimensional and engineering data, erection methods and special layout drawings are included. The Aerotec Corp.

Electrical Precipitator **202**

Electrical precipitator may be used for removal of practically any solid or liquid suspended in a gas, according to 28-page brochure. How it works, basic types and advantages are illustrated and discussed. Numerous specific installations are given. Research Corp.

Gas Scrubbers **203**

Efficient dust removal of micron and sub-mircron dusts by using cyclonic and venturi gas scrubbers is discussed in 8-page bulletin M-102. Descriptions, illustrations and performance data are presented. Chemical Construction Corp.

Cloth Screen Collector **204**

Cloth screen dust collectors are the subject of 28-page illustrated bulletin 909A, entitled "The Control of Industrial Dust". Features chapters on how it works, types of systems available, capacities and specifications along with application data and case histories. Pangborn Corp.

Wet Collectors **206**

Multi-wash wet method dust collectors are described and illustrated in 20-page bulletin 510. Design features and typical installations are included. Settling and dewatering equipment, and sludge pumps are also featured. List of available bulletins covering specific applications and equipment is also included. Claude B. Schneible Co.

Centrifugal Collector **207**

Centrifugal type collector is the subject of 12-page catalog DC-49. Efficiency, multiple arrangement, testing equipment, applications and capacities are discussed and illustrated. Layouts for specific installations are presented. The Ducon Co.

Dust Collectors **208**

Series of four folders describe cyclone type collector and portable, standard, and automatic bag type dust arrestors. Also includes 32-page catalog describing exhaust fans for dust collecting and air handling. Northern Blower Co.

Dust Collection **209**

"The Collection and Recovery of Industrial Dusts," 28-page brochure 101, explains what dust is, techniques in the analysis of dust, and factors which influence choice of collection equipment. Information on cyclone, electric precipitator, low resistance and low draft loss collectors is presented. Combination systems, special purpose collectors and hopper valves are also discussed. Buell Engineering Co.

Dust Collector **210**

Fly ash precipitator consisting of primary concentrator and secondary separator is featured in 12-page bulletin 1628. Illustrated explanation of principles of operation together with engineering specifications and construction details are presented. American Blower Corp.

Dust Collectors **211**

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrestor types are the subject of 32-page bulletin. Air conditioning, ventilating, conveying, drying, and cooling are also presented. Case histories of numerous industrial installations are illustrated. Kirk & Blum Mfg. Co.

BUILDING HEATING, VENTILATING & AIR CONDITIONING & REFRIGERATION

Unit Heaters **212**

Selection and application of blower type unit heaters from 100,000 to 1,500,000 Btu are explained in 56-page catalog DS-327-A. Includes capacity information and performance data for floor, wall and ceiling units to deliver heat directly or through ducts. Outlet arrangements, optional dampers, mixing boxes and intake boxes and filters are described. The Trane Co.

General Catalog **213**

Bring your quick reference file up to date with 36-page catalog PB-290. Condensed descriptions, data, applications and photos for full line of air conditioning, heating, ventilating and heat transfer equipment have been conveniently arranged for easy reference. Also lists bulletins available for more complete information on each product. The Trane Co.

BUILDING MATERIALS & MAINTENANCE

Vacuum Cleaning Systems **214**

Stationary vacuum cleaning systems and heavy-duty portable vacuum cleaners are presented in illustrated 8-page bulletin 125 D. Explains how to clean large areas at less cost and lists many other benefits. Special applications are included. Attachments are listed and illustrated. The Spencer Turbine Co.

Industrial Vacuum Cleaners **215**

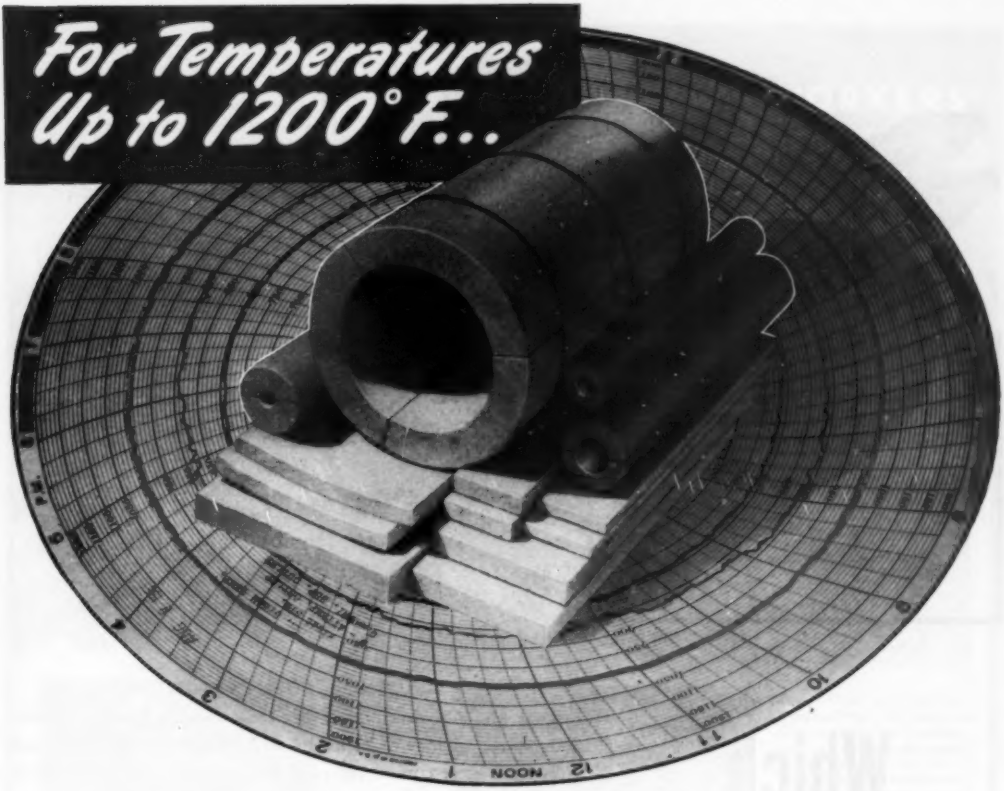
Two models of heavy-duty portable vacuum cleaners for wet or dry pick-up

(Continued on page 28)

Oil & Grease Seals **205**

This 100-page catalog 10 will make a valuable addition to your ready reference library. Seals for bearings and mechanical seals for rotary shafts are fully described and illustrated, and typical applications are pictured using drawings and cutaways. Engineering data and model numbers are listed in convenient table form. Unusual visual index is incorporated to give proper seal for each application at a glance. Special sections include: Installation instructions; trouble tips; and tips on how to order. Three pages of engineering reference tables including metric conversion table, decimal equivalents, oil viscosity, and centigrade-fahrenheit conversion are featured. Garlock Packing Co.

For Temperatures Up to 1200° F...



One Material Insulates The Entire Job — Better

Wherever the saving of heat is a factor . . . for temperatures all the way up into the superheated range, *one* material provides outstanding performance—Kaylo Heat Insulation.

The structure of this revolutionary heat-saving material, a hydrous calcium silicate, is composed of countless sub-microscopic air spaces giving it high insulating value. Its wide *effective* temperature range—up to 1200°F.—eliminates the need for combination coverings in nearly all operating conditions.

Kaylo Heat Insulation is inorganic, incombustible and insoluble in water; has remarkable dimensional stability—properties which contribute to its continued efficiency and long service life.

The high strength of Kaylo Heat Insulation makes spoilage almost negligible, in transit and on the job. Although Kaylo Heat Insulation is strong, it is extremely lightweight. Its ease of handling, cutting and fitting helps speed application.

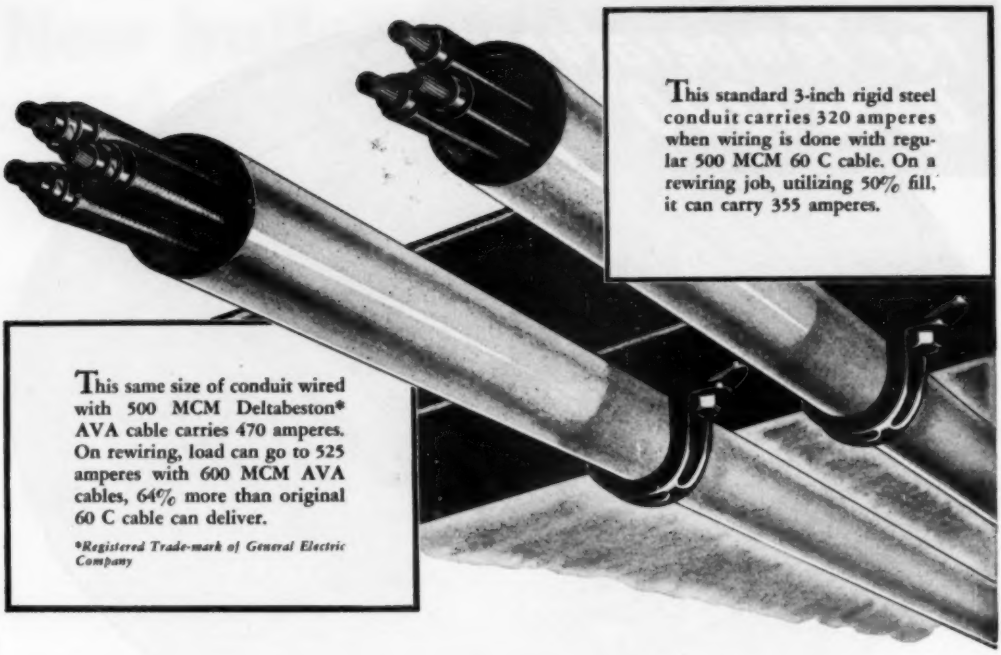
For complete details on Kaylo Heat Insulation, write Dept. N-307, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

See our CATALOG in

KAYLO® ... *first in calcium silicate*

...*pioneered by* OWENS-ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON



This standard 3-inch rigid steel conduit carries 320 amperes when wiring is done with regular 500 MCM 60 C cable. On a rewiring job, utilizing 50% fill, it can carry 355 amperes.

This same size of conduit wired with 500 MCM Deltabeston* AVA cable carries 470 amperes. On rewiring, load can go to 525 amperes with 600 MCM AVA cables, 64% more than original 60 C cable can deliver.

*Registered Trade-mark of General Electric Company

Which conduit carries more current?

Whenever you add distribution or change existing wiring systems, investigate the savings of Deltabeston AVA cable. Deltabeston can actually offer more current per pound of copper—can pack as much as 64% more current into your present raceways.

Because it's built to beat the heat with a double asbestos insulation and the famous G-E No. 1799 varnished-cambric—Deltabeston cable can take elevated temperatures in its stride. Thus, it can handle more current than ordinary types *at normal ambient temperatures.* And non-aging asbestos insulation offers the extra advantage of long service life.

Whenever you wire, look into the advantages of Deltabeston AVA cable. For further information contact your local G-E Construction Materials distributor or write Section W5-244 Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

Deltabeston
WIRES and CABLES
Built to beat the heat

You can put your confidence in—

GENERAL ELECTRIC

COPPUS "BLUE RIBBON" VENTILATORS

Identified by the blue band

FOR WORKERS'

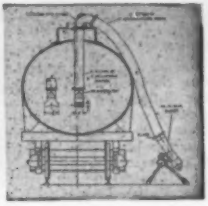
- *Safety*
- *Health*
- *Comfort*
- *Efficiency*

VANO Design "A" VENTILATOR

Vano Design "A" cooling interior of furnace, supplying fresh air through 10 feet of "Ventube" to provide safety and comfort during repair work.

Vano Design "A" delivering fresh air to cable manhole, expelling sewer gas, making entrance safe in a few minutes.

Vano Design "A" Ventilator plus a few accessories feeds large air volume into tank car, driving out fumes, stagnant or hot air for workers' safety and comfort.



Vano Design "A" supplying fresh air in Reactor Room of Synthetic Rubber Plant.

Vano Design "A" Ventilator supplying fresh air to men working in wing compartments, fuselages, etc.

Powered by a ½ hp motor, and equipped with the exclusive Coppus axial-flow propeller-type fan, this general-purpose blower delivers 1500 CFM of fresh air. It supplies ventilation for tanks, tank cars, drums, vats, underground cable manholes, pipe galleries, airplane wing compartments and fuselages, and other confined places. Weighs only 103 lbs. Uses 8"-diameter flexible canvas tubing ("Ventube").

VANO DESIGN "C"

VENTILATOR-EXHAUSTER

Vano Design "C" equipped with 8" discharge tubing removing welding fumes.

Vano Design "C" equipped with two suction lines removing welding fumes for operators' safety.

For withdrawing welding fumes from confined places or directly from the welding rod ...or for expelling fumes or hot air from enclosed vessels. You can get it with 8" suction inlet for 8" non-collapsible tubing ...or with multiple inlet nozzles for 5", 4" or 3" suction hose. The discharge outlet takes 8" "Ventube". Powered by a ½ hp motor, it weighs only 85 lbs.

NAME.....

COMPANY.....

ADDRESS.....

CITY.....

COPPUS "BLUE RIBBON" PRODUCTS—*Designed for Your Industry, Engineered for You*

New bulletins and catalogs

(Continued from page 24)

are described and illustrated in data sheets 22-50 and 22-60. Includes descriptions of attachments. General Electric Co., Appliance and Merchandise Dept.

BOILERS & BOILER ACCESSORIES

Smoke Recorder **216**

If you are concerned with smoke abatement, bulletins 512 and 5101 should be of interest. Descriptions, data and illustrations are presented on electric smoke recorder, smoke periscope and lens-type furnace indicator. Ess Specialty Corp.

COAL, ASH & BULK HANDLING

Conveyor **217**

Unusual conveyer for transportation of fine materials is fully explained in 8-page bulletin FH-2. This conveyer may solve your dust and maintenance problems. It is completely closed and has no moving parts. Catalog explains that pulverized materials flow like water. Illustrated with drawing and photos. Fuller Co.

Belt Conveyer Carriers **218**

Belt conveyer carriers are the subject of 20-page bulletin 2C. Complete information on types for practically any bulk material handling application is given. Lists features, applications, sizes and dimensions of each style along with lubrication and maintenance data. Photographs, cutaways and drawings show full particulars of the units. Stephens-Adamson Mfg. Co.

Coal Handling **219**

Ideas and suggestions for solving the coal and ash handling problems of today's power plants are presented as part of 44-page book 2410. Also contains helpful layout drawings and photographs of actual installations at both large and small public utility, industrial and public building power plants. Includes sections on unloading coal, auxiliary unloading, coal storage and reclaiming, crushers, transporting and distributing equipment, ash handling equipment and water intake screens. Link-Belt Co.

Pneumatic Conveyers **221**

Booklet 6a will be a valuable addition to your reference library. Pneumatic conveyers for ash, chip and bulk handling are described and actual installations are illustrated with photos and layout drawings. This 8-page bulletin is presented in a convenient quick reference style. National Conveyors Co., Inc.

Weighing Systems **222**

If your problem is to control the weights or rates of flow of materials in your plant, you should find 56-page brochure 841 a valuable source of information. Diversified line of weighing, batching and proportioning systems are discussed and illustrated. Features, applications and specifications are given. Includes useful information on how to determine the valley angle of a hopper and a table of densities of typical solids as they occur in material handling. Jeffrey Mfg. Co.

HOW TO REQUEST FREE BULLETINS

Insert "key" numbers on return post card found on page 131. Our Reader's Service Department will handle your request promptly.

Conveyor Belt **223**

If you have conveyer belt difficulties an illustrated 4-page folder 6915 featuring a recently developed belt may be of interest. Booklet claims many benefits for product. Raybestos-Manhattan, Inc., Manhattan Rubber Div.

Belt Conveyors **224**

"Belt Conveyers . . Industry's Bulk Handling Giant" is an interesting 24-page booklet which clearly tells of the development of belt conveyers and their present day importance. Included are photos of installations in many diversified industries. Booklet is a copy of a paper presented to ASME. Link-Belt Co.

Heating Coils **220**

Steam and hot water coils for a wide range of applications in both standard and non-freeze types are described in 66-page booklet DS-385. Extended surface heating coils are available in stainless steel, Inconel, monel, copper, aluminum and steel. Advantages, construction and applications are presented in a quick reference style and illustrated with photos, drawings and diagrams. Useful information on capacities, selection, performance, installation and dimensions is included. Also presents tables of pipe capacities under varying steam conditions for your personal files. Numerous other products manufactured by the company are listed and illustrated. The Trane Co.

COMPRESSORS

Air Compressors **225**

Illustrations and descriptions of belt drive and direct motor drive stationary air compressors from ½ to 100 hp are presented in 12-page catalog 5110. Features are listed, and engineering specifications and dimensions are included. Schramm, Inc.

Compressor Accessories **226**

"Is Your Air Compressor Capacity Effective?" is the title of 8-page technical bulletin 5, intended to aid you in improving the effective capacity and efficiency of your compressor. Booklet contains 6 pages of useful engineering information, including graphs and piping diagrams. Dimensions, descriptions and illustrations of cooling controls, automatic drain traps, safety controls and strainers are briefly presented. Sarco Company, Inc.

Air Compressors **227**

Complete engineering data for a line of single and two stage motor-driven compressors from 250 to 1000 hp are presented in 4-page bulletin M-65. You will want these data in your quick reference file. Features cutaway view of compressor. Also illustrated with photos. Cooper-Bessemer Corp.

CONTROLS, REGULATORS & INSTRUMENTS

General Catalog **228**

Brief descriptions and illustrations of approximately 100 measuring and control instruments and valves are contained in 28-page catalog 5000. Incorporates an index and is arranged in a quick-reference style to be of additional value to your reference file. Minneapolis-Honeywell Regulator Co., Industrial Div.

Regulating Valve **229**

Large cutaway illustration of a pilot-operated regulating valve with detailed explanations of design features is presented in 4-page folder 700. Includes discussions on how control function of valve can be changed by using a different sensitive pilot. Spence Engineering Co., Inc.

Non-frosting Gages **230**

Data sheet 177, describing line of non-frosting gages, is offered for your ready reference library. Cross-section drawings of transparent and reflex types are included. Jerguson Gage & Valve Co.

Self-operated Controllers **231**

Complete engineering data and specifications for a line of automatic temperature and pressure controllers are presented in 4-page illustrated folder 1320. Applications such as hot water storage heater, tanks and exhaust boxes are listed. Weston Electrical Instrument Corp., Tagliabue Instruments Div.

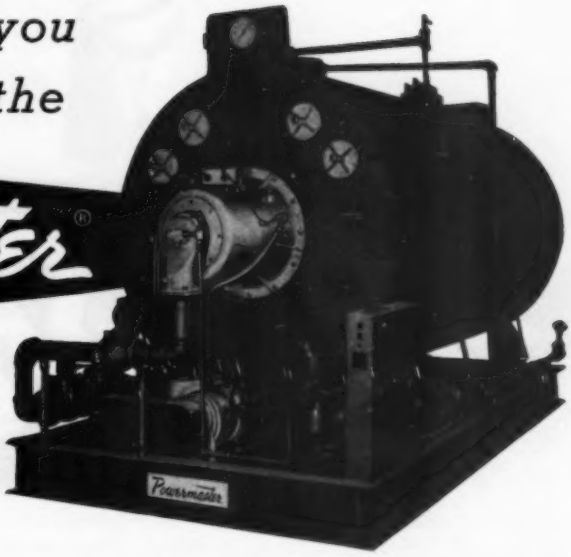
Boiler Plant Instrumentation **232**

Is the boiler plant one of your services? You may find 24-page booklet 51-605 useful as a guide for instrumentation problems. Indexed for quick reference, each instrument, gage and con-

(Continued on page 32)

to get all 3 benefits
be sure you
find out about the

Powermaster®



Model 3 *Powermaster*—15 to 500 H.P.—high or low pressure units for steam or hot water

1 *Low cost operation* for steam or hot water—because the special *Powermaster* burner design (patent applied for) gives you top efficiency when operating anywhere between 30% and 100% of boiler capacity.

2 *Less clean-up* time and money are real benefits when you use a *Powermaster.* In plant after plant, job records *prove* that the design of this packaged steam generator means less smoke, less soot to be cleaned from tubes.

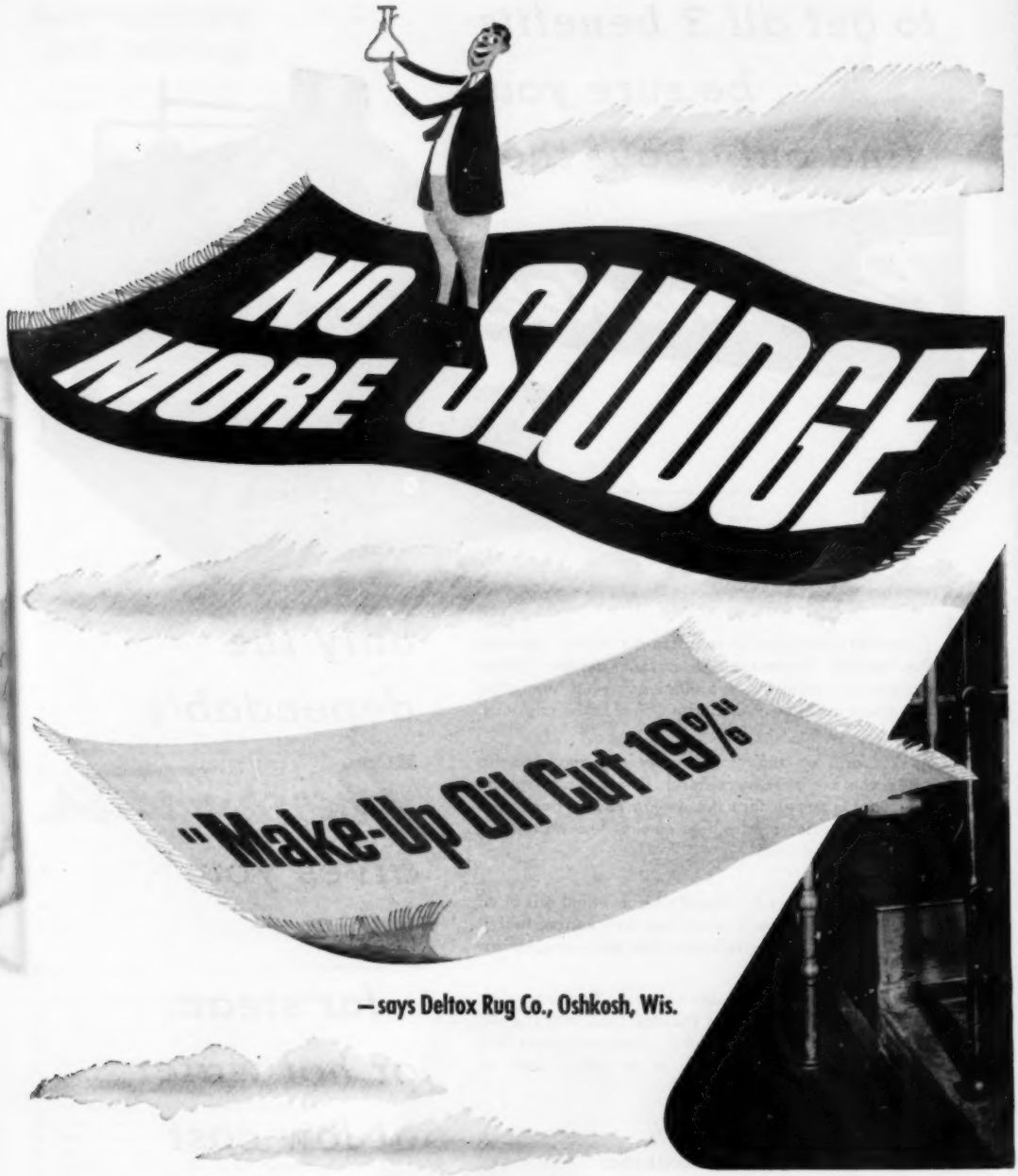
3 *Get low fuel rates* by changing from either gas or oil in just a few minutes. You can use the cheaper fuel at any time. And no worries about fuel shortages, either.

To find out what is new and better about the *Powermaster,* all you do is ask for a copy of Bulletin 1218. It gives you complete details about this unit's improved safety and automatic control features. Ask us to put a copy of Bulletin 1218 in the mail for you.

We'll mail you a copy of this book that gives the reasons why you cut operating costs with the Powermaster. Just ask for a copy of Bulletin No. 1218.

only the
dependable
Powermaster®
gives you
all 3
—for steam
or hot water
at low cost

ORR & SEMBOWER, INC., *Established 1885*
950 Morgantown Road, Reading, Pennsylvania



SINCLAIR OILS

Fine, smartly-designed fibre rugs made by the Deltox Rug Company are favorites with budget-wise consumers from coast to coast. The Deltox plant, in Oshkosh, Wis., generates its power with an Ames 4 cyl. Uniflow Steam Engine, shown here.

At first, this engine was giving Deltox engineers trouble with sludging and oil emulsification in the circulating system. Then, about a year ago, Deltox changed to Sinclair RUBILENE® Oil Medium. The gauge glass was watched vigilantly, but there was no evidence of emulsification or developing sludge.

Besides ending emulsification and sludging, the subsequent yearly overhaul showed practically no valve cam or bearing wear; and carbon deposits in the valve gearing were negligible. Furthermore, a check of past records showed a cut of 19% in make-up oil.

MAKING A CHECK. Sinclair Rubilene shows complete separation from water.

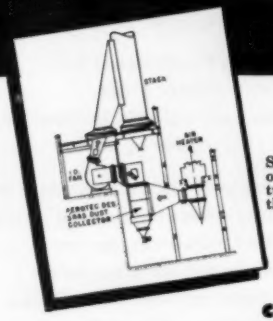
Are you getting full satisfaction from the circulating systems in your plant? Perhaps a Sinclair Engineer can save you maintenance and operating expense. Get in touch with your nearest Sinclair Representative, or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

for circulating systems

another power plant application of the

AEROTEC DUST COLLECTOR

promoting better community relations



Riverton Station
Northern Virginia Power Company

Sectional drawing shows location of AEROTEC Dust Collector between air heater and I.D. fan at this Riverton Station.

Promote your community relations

the highly efficient Aerotec way

A clean stack has proven time and again to pay valuable dividends in community good will. To gain this advantage, plus plant erection and maintenance economies, public utilities are specifying the Aerotec Design 3 RAS Dust Collector. This unit develops a higher centrifugal force through the use of multiple, small-diameter tubes, resulting in exceptionally high efficiencies on ultra-fine dusts.

Flexible and space-saving

The tubes are permanent mold aluminum and closely nested to provide lighter weight and more capacity per square foot of plan area than any collector of comparable efficiency. They are set at a 45° angle on vertical tube sheets, factory-assembled into lightweight "building block" sections that reduce installation time and permit the Aerotec Design 3 RAS to be easily tailored to fit available space.

Our field engineers specialize in solving flyash collection problems and welcome the opportunity to assist you at any time. Call or write. No obligation.

Project Engineers

THE THERMIX CORPORATION
GREENWICH, CONN.
(Offices in 38 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD.
Montreal 25, Quebec — Toronto 3, Ontario

THE AEROTEC CORPORATION
GREENWICH, CONN.

New bulletins and catalogs

(Continued from page 28)

trol is briefly discussed and illustrated. Control elements, controller components, panels, operation and advantages are described. Four pages of layout drawings and descriptions of standard control systems are featured. Useful table lists most boiler room instruments, types and functions. The Hays Corp.

Low Resistance Ohmmeter **233**

General purpose low resistance ohmmeters are described in illustrated 4-page folder 24-26. Includes information on calibration, accuracy, testing leads, protective relay, power supply, operating instructions and specifications. James G. Biddle Co.

CO_2 Recorder **234**

Informative 12-page booklet 51-1008 features CO_2 recorder constructed for boiler plant use. Includes illustrations and discussions on operation of the analyzing and recording sections, component parts and features, and gas sampling systems. The Hays Corp.

HOW TO REQUEST FREE BULLETINS

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ELECTRICAL DISTRIBUTION

Power Cables **235**

"Selection of Proper Cable Sizes" 12-page bulletin 19-269, is presented as a simple method of selecting proper conductor size for heat-resistant wire and cable in installations typical of those coming under the cognizance of the National Electrical Code. Many useful formulas and tables are included. General Electric Co., Construction Materials Dept.

Motor Starters **236**

If you are concerned with motor starters this 8-page brochure presenting a complete line of multi-speed and reversing starters should be a valuable addition to your file. Features listed include small size and light weight. Sizes range from 1 hp at 110 v to 100 hp at 440-550 v. Descriptions and illustrations are arranged for quick reference, and a convenient specification sheet is featured. The Arrow-Hart & Hegeman Electric Co.

Dry-type Transformers **237**

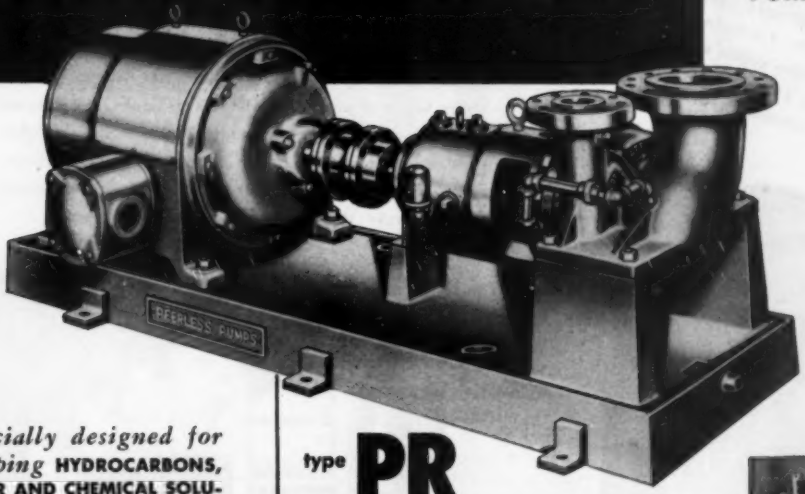
Bring your reference file up to date with illustrated 8-page bulletin 61X-7088B containing the proposed AIEE guide for the use of openly ventilated dry-type transformers with Class B insulation. Includes general recommendations on installation, inspection, storage, maintenance, and operation

(Continued on page 170)

PEERLESS TYPE PR

A CENTER-LINE-MOUNT PUMP FOR HEAVY DUTY PROCESS SERVICE IN REFINERIES AND CHEMICAL PLANTS

Peerless BUILDS **DEPENDABLE PUMPS**



Especially designed for pumping **HYDROCARBONS, WATER AND CHEMICAL SOLUTIONS AT ELEVATED TEMPERATURES AND PRESSURES...**

CHARACTERISTICS AT A GLANCE

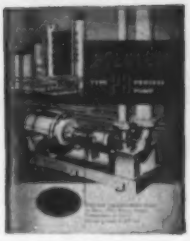
CAPACITIES	Up to 1000 gpm
OPERATING HEADS	Up to 625 feet
TEMPERATURES	Up to 850° F.
CASE PRESSURES	Up to 600 psi
DRIVES	Horizontal electric motor is standard; others as required, such as steam turbine drive or stationary engine drive.
MATERIALS OF CONSTRUCTION	Liquid end can be furnished in cast iron, bronze, carbon steel, stainless steel or other materials as required for the intended service.
LIQUIDS HANDLED	Hot oil, propane, butane and all petroleum hydrocarbons, process liquids and water.
NPSH CHARACTERISTICS	Designed to operate with minimum available NPSH.

type **PR**

FOR THOSE TOUGH HIGH-TEMPERATURE AND HIGH-PRESSURE APPLICATIONS IN REFINERY AND PROCESS WORK . . .

Maximum interchangeability, extra-heavy wall thicknesses, extra-low NPSH requirements and extra-rigid case-frame construction make the Peerless Type PR pump ideal for those rugged duty jobs in a large number of industrial services.

Furnished in a complete range of sizes, a Peerless Type PR will cover nearly all your pump needs. Available in various alloy materials. Adequate water-cooling jackets and water-cooled stuffing box, with mechanical seal optional, and heavy duty shaft with carefully balanced bearing design are features of the Peerless Type PR construction. Many sizes are available from stock in standard materials.



New Bulletin just off the press

Use coupon for Bulletin No. B-1605 which describes the exacting design and construction features of Peerless Type PR pumps.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Address inquiries to Factories at:
Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York, Chicago, St. Louis, Atlanta; Dallas, Plainview and Lubbock, Texas; Fresno; Los Angeles; Phoenix; Albuquerque, N. M., Tulsa

fmc

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send us copy of Peerless Type PR Pump Bulletin No. B-1605.

NAME _____

COMPANY _____

STREET _____

CITY _____ STATE _____

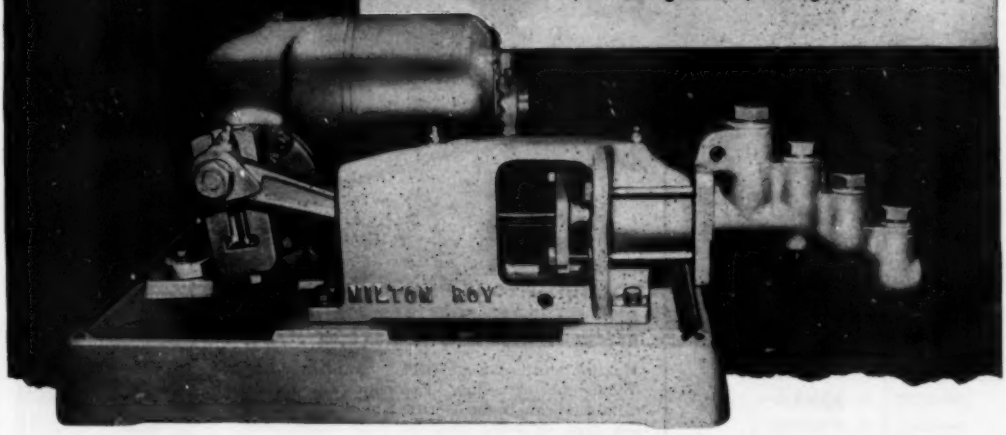
I & P

This is Controlled Volume Pumping

Boiler feed water treatment: Pumping 10.5 gph of 3% di-sodium phosphate at 1250 psi directly into the boiler drum. Pumping 2 gph of sodium sulfite at 100 psi into the storage space of the deaerating heater.

THIS MILTON ROY CONTROLLED VOLUME PUMP DOES THE JOB . . .

It's a Milton Roy Simplex. At a large western power plant, four of these pumps—2 on standby service—help do these things: precipitate calcium and magnesium salts, control alkalinity, prevent corrosion and embrittlement in the boiler drum. Residual dissolved oxygen is scientifically removed from the boiler feed water. One of many types of precision Milton Roy Controlled Volume Pumps, this particular unit, which can be supplied within capacity ranges of 1 pint to 340 gph against pressures up to 5000 psi, was installed complete with chemical solution tanks, dissolving baskets, and agitators.



Boiler feed water treatment is an accepted application of the Milton Roy principle of controlled volume pumping. And Milton Roy Pumps have worldwide use in all phases of scientific treatment of boiler feed water—in all forms of internal and external chemical feed systems. Here are a few: metering of chemicals to the suction side of the boiler feed pump; introduction of chemicals directly to boiler drums; intermittent feeding followed by condensate flushing; automatic chemical injection in ratio to flow; automatic pH control; automatic control by conductivity.

These pumps give flawless service. They have the advantages of design simplicity, low upkeep, low cost.

For additional information on Milton Roy Controlled Volume Pumps for boiler water treatment: Call the Milton Roy representative listed in your classified telephone directory. Or write us direct.

MILTON Roy COMPANY

1319 EAST MERMAID LANE, PHILADELPHIA 18, PA.

MANUFACTURERS OF CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

STOP RUST! with RUST-OLEUM

Protects Tanks, Pipes, Girders, Metal Sash, Fences, Roofs and Buildings, Rail and Marine Facilities

BEAUTIFY AS YOU PROTECT—ALL COLORS, ALUMINUM AND WHITE!

RUST-OLEUM may be applied directly over *rusted surfaces without removing all the rust!* Just remove rust scale and loose particles with wire brush and sharp scrapers... then apply by brush, dip, or spray. Costly sandblasting and chemical pre-cleaning are not usually required. Easy as that to cut your maintenance costs. Specify **RUST-OLEUM** to your painting contractor or architect for *every rustable* metal surface! Prompt delivery from Industrial Distributor stocks in principal cities.

RUST-OLEUM CORPORATION
2472 Oakton Street • Evanston, Illinois

FREE SURVEY: A **RUST-OLEUM** specialist will gladly survey your rust problems. He'll make specific tests and recommendations. No cost or obligation. See Sweets for complete catalog and nearest **RUST-OLEUM** distributor, or write for literature on your company letterhead.

Stopping Rust with **RUST-OLEUM** 769 O. P. Red Primer

CLIP THIS TO YOUR LETTERHEAD
MAIL TO: RUST-OLEUM CORPORATION
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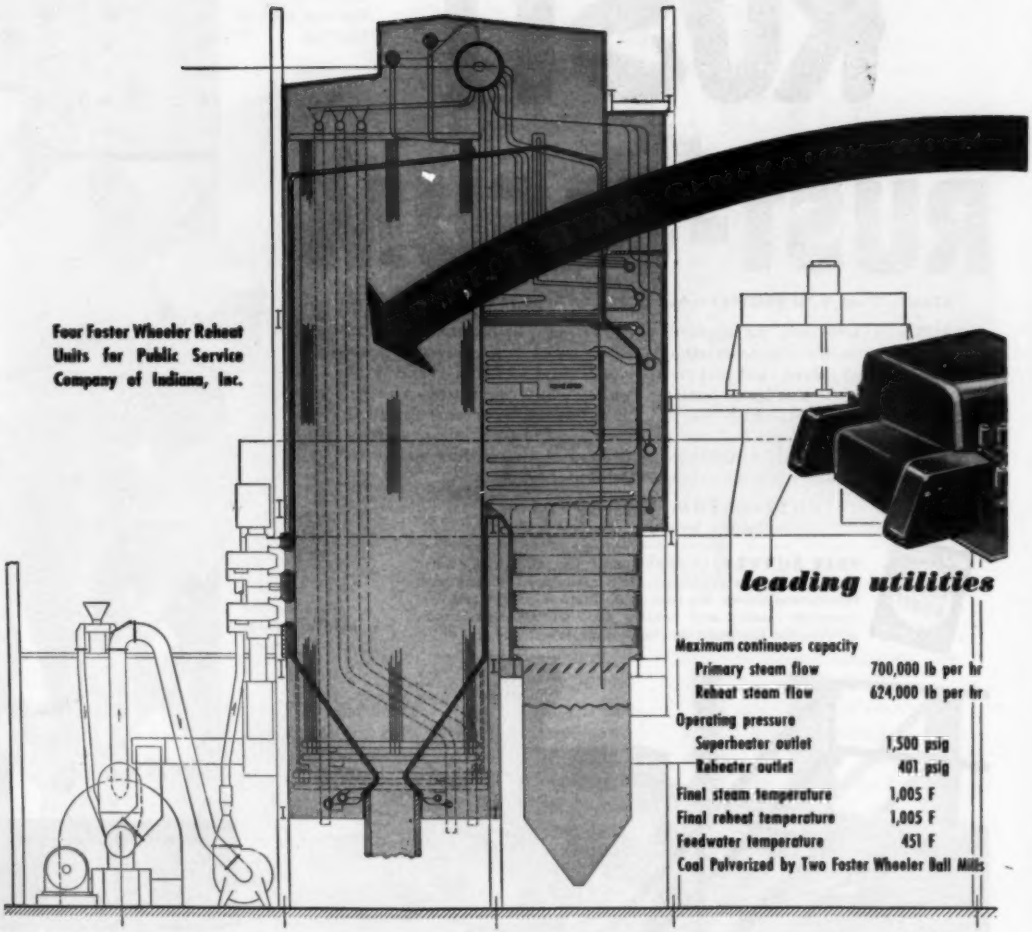
- ☐ Have a Qualified Representative Call
- ☐ Full Details on Free Survey
- ☐ Complete Literature
- ☐ Nearest RUST-OLEUM Source

Look for this label – be sure it's genuine **RUST-OLEUM**

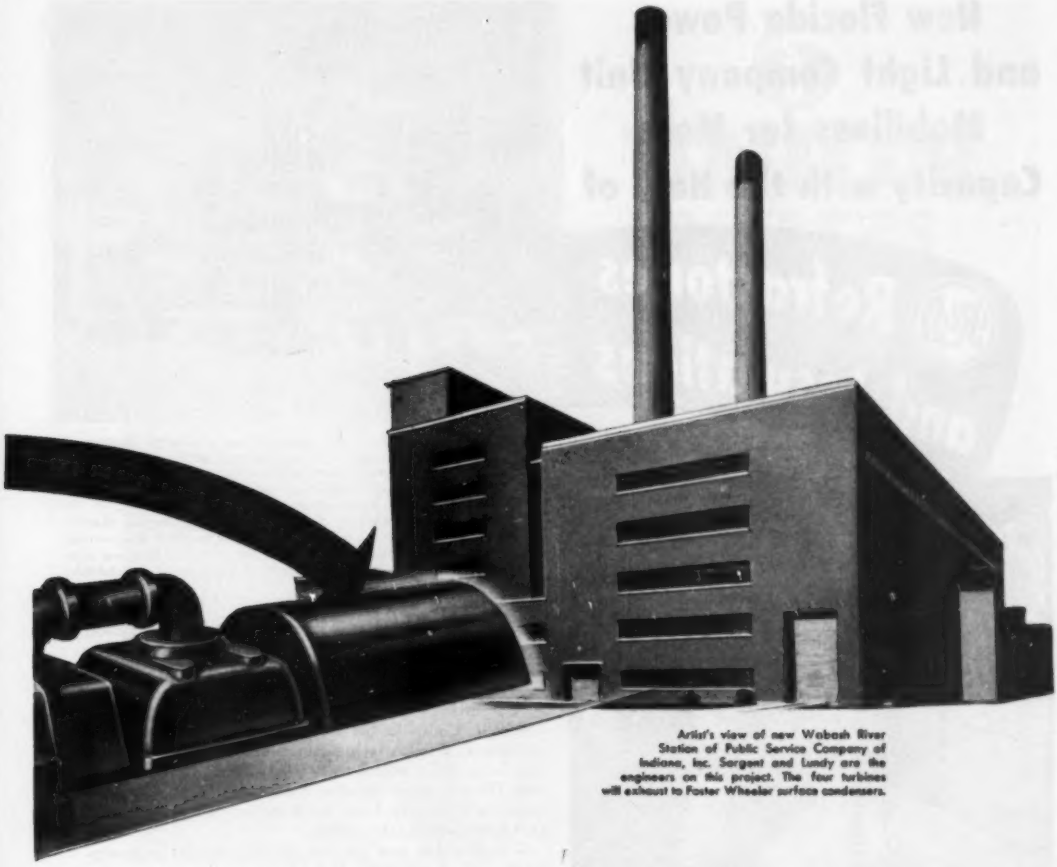
Integrating



Four Foster Wheeler Reheat Units for Public Service Company of Indiana, Inc.

leading utilities

Maximum continuous capacity	
Primary steam flow	700,000 lb per hr
Reheat steam flow	624,000 lb per hr
Operating pressure	
Superheater outlet	1,500 psig
Reheater outlet	401 psig
Final steam temperature	1,005 F
Final reheat temperature	1,005 F
Feedwater temperature	451 F
Coal Pulverized by Two Foster Wheeler Ball Mills	



Artist's view of new Wabash River Station of Public Service Company of Indiana, Inc. Sargent and Lundy are the engineers on this project. The four turbines will exhaust to Foster Wheeler surface condensers.

are ordering Foster Wheeler reheat steam generators

The large investment in present day power plant equipment dictates the careful selection of major components so as to avoid costly forced outages. Foster Wheeler engineers have always sought to refine the techniques of steam generation. They therefore took an early interest in the development of reheat where operating and control characteristics of the reheat boiler are integrated with those of the reheat turbine during every phase of service. Almost three decades ago, these engineers were responsible for the utilization of the characteristics of radiant and convection superheaters in series. Over "500 radiant superheater years" in one utility alone attest to the reliability of radiant surface for superheating.

The reheat steam generator illustrated is designed with a combination radiant and convection superheater and an all convection reheater. The chief advantages of this type of Foster Wheeler reheat steam generator may be listed as follows:

- complete freedom from furnace slagging is assured because furnace can be designed to suit fuel characteristics rather than reheat cycle duty requirements
- permissible wider selection of fuel of varying slagging characteristics
- location of the reheater deep in the convection zone assures safer metal temperatures during all starting, shutting down, and emergency operating conditions

This design also incorporates such features as:

- complete drainability of all superheating and reheating surfaces essential to quick and normal starts
- wide range of precise control of final steam temperature
- fully independent means of controlling primary and reheat steam temperatures.

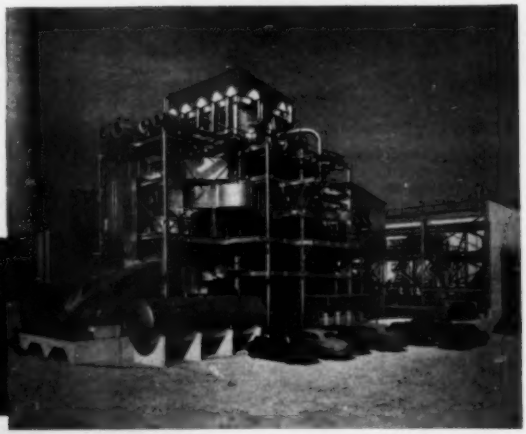
These features provide for complete integrating of steam generating unit with turbine requirements under normal, quick start or emergency conditions.

FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.

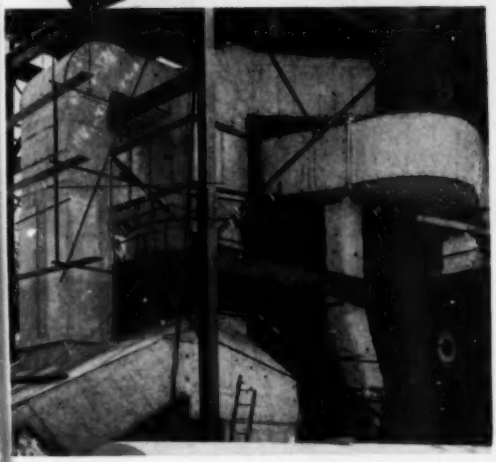
FOSTER WHEELER

New Florida Power and Light Company Unit Mobilizes for More Capacity with the Help of

R&I Refractories and Insulations



1950 Extension to the Sarasota Steam Electric Station of the Florida Power & Light Company at Sarasota, Florida.
Engineers and Constructors—Ebasco Services Inc.
Boilers—Combustion Engineering Superheater, Inc.
Air Heater—Air Preheater Corp.
Another example of how private capital in the electric utility industry is making full use of modern engineering practices and developments—a big factor in keeping electric service costs low and service even more dependable.



Large air preheater and hot air ducts covered with R & I Mineral Wool Blanket Insulation over which a coat of Stic-Tite Insulating Cement was subsequently applied.

Specifications for F. P. & L.'s extension to their power generating plant called for boiler refractory linings and insulation coverings that could really "take it" and last longer. R & I Products were selected for the job. Bonding Cements for the boiler settings; Moldit Castable Cements for baffles and other monolithic construction; Insulating Block and Stic-Tite Insulating Cement for boiler walls; Insulating Blankets and Stic-Tite for air preheater and hot air ducts, etc. It all came to a mighty large package of superior service and installation satisfaction.

Whether for new or old power generation equipment, with dependable R & I Refractories to resist the heat, and R & I Insulations to conserve it, you can be sure of the maximum in operating efficiency and the minimum in downtime for repairs. Discover why—your best buy—is R & I.

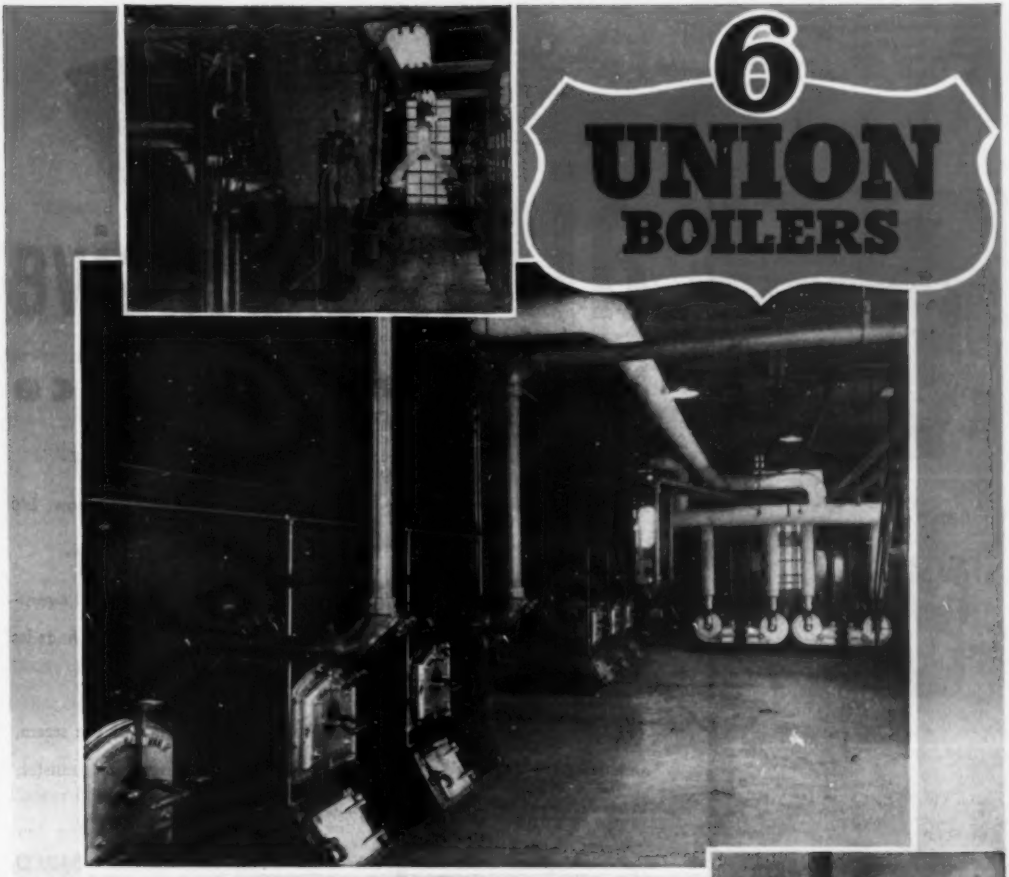
SUPER #3000 REFRACTORY CEMENT	MOLDIT CASTABLE REFRACTORY CEMENTS	INSULATING BLOCK AND BLANKETS	STIC-TITE PLASTIC INSULATION	MANY OTHER R & I PRODUCTS
The strongest ready-mixed mortar for laying fire brick, washcoating refractories and repairing worn or eroded parts. Sticks tighter, sets harder, lasts longer.	Make poured refractory shapes of any size—arches, baffles, walls, doors, floors, ash pit walls, burner blocks, etc. Ready in hours instead of days. For all temperatures and erosion conditions.	R & I single layer block insulation for all temperatures to 2000° F. Strong, efficient, water-resistant. R & I mineral wool blankets in standard or special sizes; with all styles of metal reinforcement.	An all-purpose, durable covering for heating equipment, ducts, piping, fittings, etc. Strong, light, adhesive, easy to apply on other insulation, metal or brick. Recoatmobile. Very efficient to 1800° F.	Chrome base castable cements, heat-setting bonding cements, ramming type refractories; wet or dry fill insulations; expansion joint material, asphaltic weatherproofing and mastic coatings.

Get the New R & I Catalog on These and Other R & I Products

REFRACTORY & INSULATION CORP.

118 WALL STREET • NEW YORK 5, N. Y.

Offices in Chicago, Cleveland, Philadelphia, Newark, N. J.



Serve BASSETT FURNITURE INDUSTRIES INC.

SIX Union 2 Drum Type "VO" Steam Generating Units having a capacity of 40,000 pounds of steam per hour each, furnish steam for power and process for 3 divisions of Bassett Furniture Industries Inc.

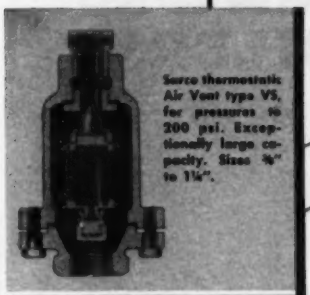
These units are of a special design for burning kiln dried wood refuse under fully automatic control.

The furnace and firing equipment burns coal during periods when wood refuse is not available.

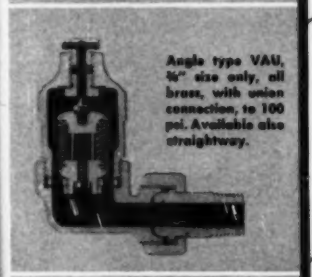
UNION IRON WORKS . . . *Since 1890*

373 CASCADE STREET • ERIE, PENNA.

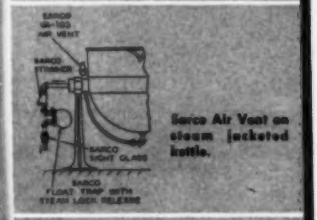
BOILERS • PROCESS EQUIPMENT • FABRICATED STEEL



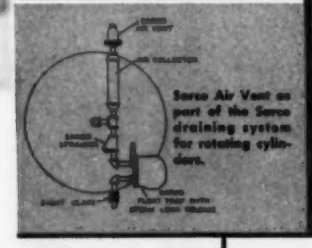
Sarco thermostatic Air Vent type VS, for pressures to 200 psi. Exceptionally large capacity. Sizes ¾" to 1¼".



Angle type VAU, ¾" size only, all brass, with union connection, to 100 psi. Available also straightway.



Sarco Air Vent on steam jacketed kettle.



Sarco Air Vent as part of the Sarco draining system for rotating cylinders.

333

air is expensive in the wrong place

Air is to be found everywhere – indoors, outdoors, above and below. It's difficult to think of it as expensive – it's so plentiful!

But air is to be found also in the steam spaces of your steam heated equipment. The air dissolved in the feed water supplied to your boilers finds its way into the heaters with the steam.

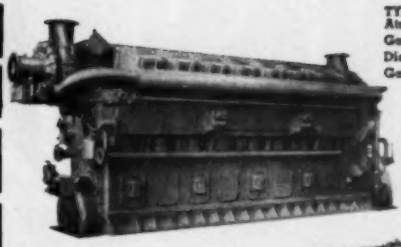
This air *is* expensive – because it reduces the temperature of the steam, and coats the heating surfaces with a film which retards heat transfer, lowers output, and increases losses.

Remove expensive air from your steam heated machines with SARCO THERMOSTATIC AIR VENTS, scientifically designed for this express purpose.

Write for BULLETIN 2751 and the name of the Sarco man nearest you. He will be glad to help you select the best type of vent for your purpose, and the right place to install it for best results.

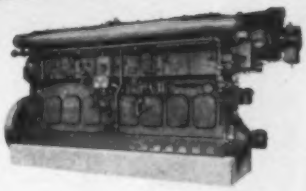
SARCO ELIMINATES AIR

SARCO COMPANY, INC.
EMPIRE STATE BUILDING, NEW YORK 1, N. Y.
Represented in Principal Cities
SARCO CANADA LTD., TORONTO 5, ONTARIO



TYPE LSV ..... 12 or 16 cyl.
Atmospheric and Supercharged
Gas ..... 1440 to 3700 hp.
Diesel ..... 1650 to 3700 hp.
Gas-Diesel ..... 1650 to 3700 hp.

● Identified here are five of the most popular Cooper-Bessemer stationary engine types—in a power range from 290 to 3700 bhp. Not only does each type offer variety in the number of cylinders, but most are available as gas engines, gas-diesels or full diesels. Moreover each type comes either atmospheric or supercharged.



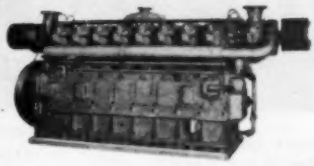
TYPE LS ..... 6, 7 or 8 cyl.
Atmospheric and Supercharged
Gas ..... 720 to 1850 hp.
Diesel ..... 825 to 1850 hp.
Gas-Diesel ..... 825 to 1850 hp.

WHEN IT COMES TO POWER...

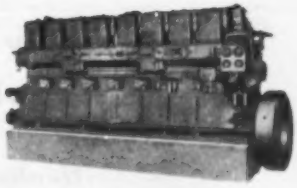
the better it "fits", the less it costs!

This gives you some idea of how well Cooper-Bessemer is prepared to meet your power requirements ideally — with the engine qualities that mean a whale of a lot in trouble-free service and especially in low over-all operating costs!

If your plans call for defense-supporting power, be sure to check with Cooper-Bessemer. Get all the facts on features that pay off for Cooper-Bessemer users time and time again.



TYPE FV ..... 6, 8, 12 or 16 cyl.
Diesel—
Atmospheric ..... 290 to 1230 hp.
Diesel—
Supercharged ..... 420 to 1850 hp.



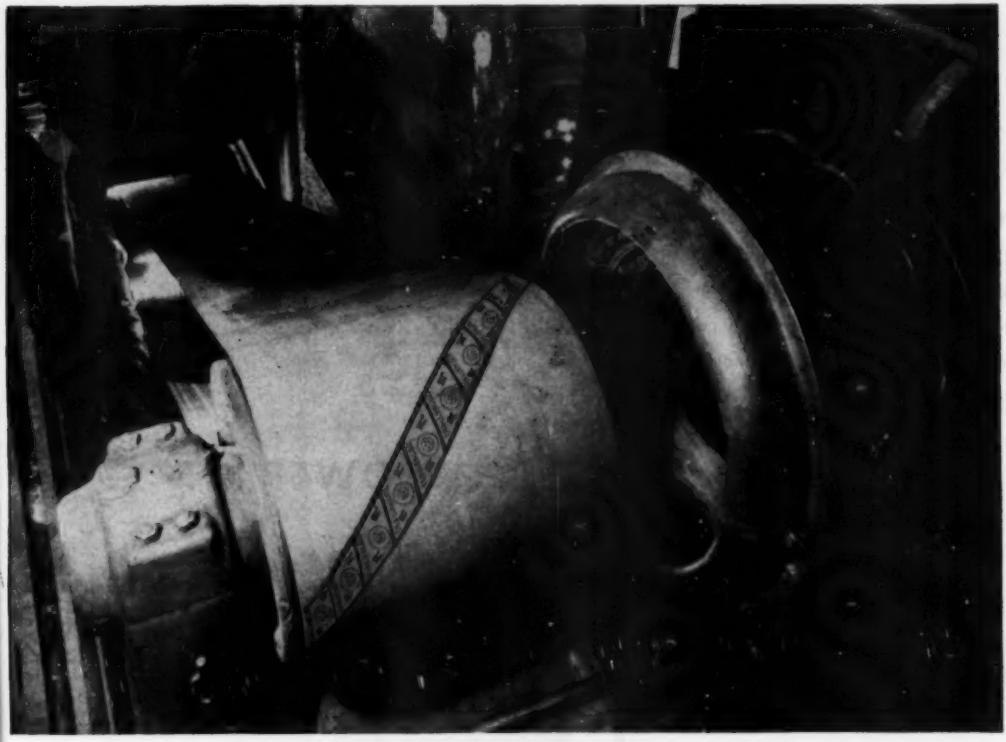
TYPE JS ..... 5, 6, 7 or 8 cyl.
Atmospheric and Supercharged
Gas ..... 375 to 1500 hp.
Diesel ..... 430 to 1500 hp.
Gas-Diesel ..... 430 to 1500 hp.

TYPE GS ..... 5, 6 or 8 cyl.
Atmospheric and Supercharged
Gas ..... 320 to 1200 hp.
Diesel ..... 300 to 1200 hp.
Gas-Diesel ..... 300 to 1200 hp.

The
Cooper-Bessemer
Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. Calmes Engineering Co., New Orleans, La.



for really efficient power transmission . . . it's Republic Rubber's *Challenger* Belting

No mistake about it. When it's a question of power delivery, the answer is Republic's Challenger Transmission Belting—the top performer of them all!

Challenger has been designed to handle your most difficult job. It's a flexible pre-stretched belt made of heavy, hard-woven, rubber-impregnated fabric for maximum service life. Challenger is an exceptional belt, being adaptable for long satisfactory service on heavy industrial drives subject to shocks and stresses, and also for drives operating at high speeds over small pulleys.

Challenger Belting is free from fastener trouble, and both top and bottom surfaces have special non-slip friction for better pulley traction. The edges are sealed against moisture, fumes and other deteriorating factors. Challenger is also fabricated with heat-resisting compounds for special operating conditions.

Standard plies and widths are available in roll lengths or tailor-made to specified endless lengths. Consult your nearby Republic Distributor today about your particular needs.

Remember, Republic Rubber has been *the* specialist in the mechanical rubber goods field for more than 48 years.

INDUSTRIAL RUBBER PRODUCTS BY

REPUBLIC RUBBER DIVISION

Lee Rubber & Tire Corporation

YOUNGSTOWN, OHIO

NOW STANDARDIZED

3 Precision Controls for All Speed Problems

Here's governor standardization that "pays off". Now you can economically solve all speed-control problems with only three basic governors.

Costly special engineering is eliminated. Advanced design gives an unusual degree of flexibility . . . with precise speed control for all steam conditions. Results? Initial costs are lower . . . shipments are quicker . . . spare-parts inventory is reduced.

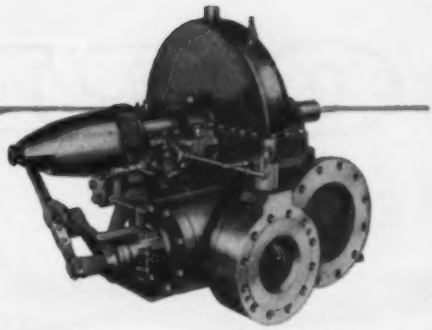
Designs for three basic classes of steam conditions, three wheel sizes, and three types of governors provide, in effect, twenty-seven standard variations to cover a wide range of applications. All oil-governed, direct-connected Type E units include the standard reservoir-type base, as illustrated. What's more, Type E governors can meet a great number of special requirements with optional accessories. This standardization results directly from Westinghouse's wide experience in all industry.

Other outstanding maintenance-saving features on the Type E turbine are Dual Protection . . . Weather Protection . . . Centerline Support . . . and a Rugged Governor Housing. Ratings are available from 5 to 1,500 hp.

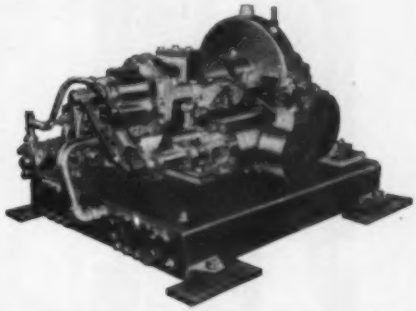
For complete information ask your nearby Westinghouse representative for Type E Turbine Book B-3896, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

YOU CAN BE SURE . . IF IT'S Westinghouse

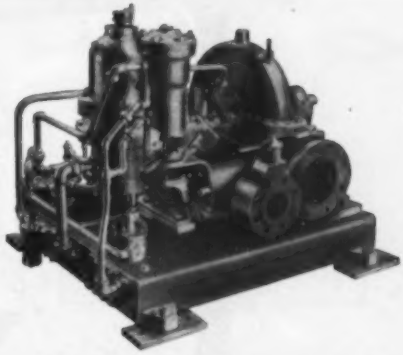
TYPE E Turbines



Shaft-Type Governor. For narrow speed-range applications, this governor automatically positions the steam admission valve to control turbine speed within close limits—*6 to 8% speed regulation.*



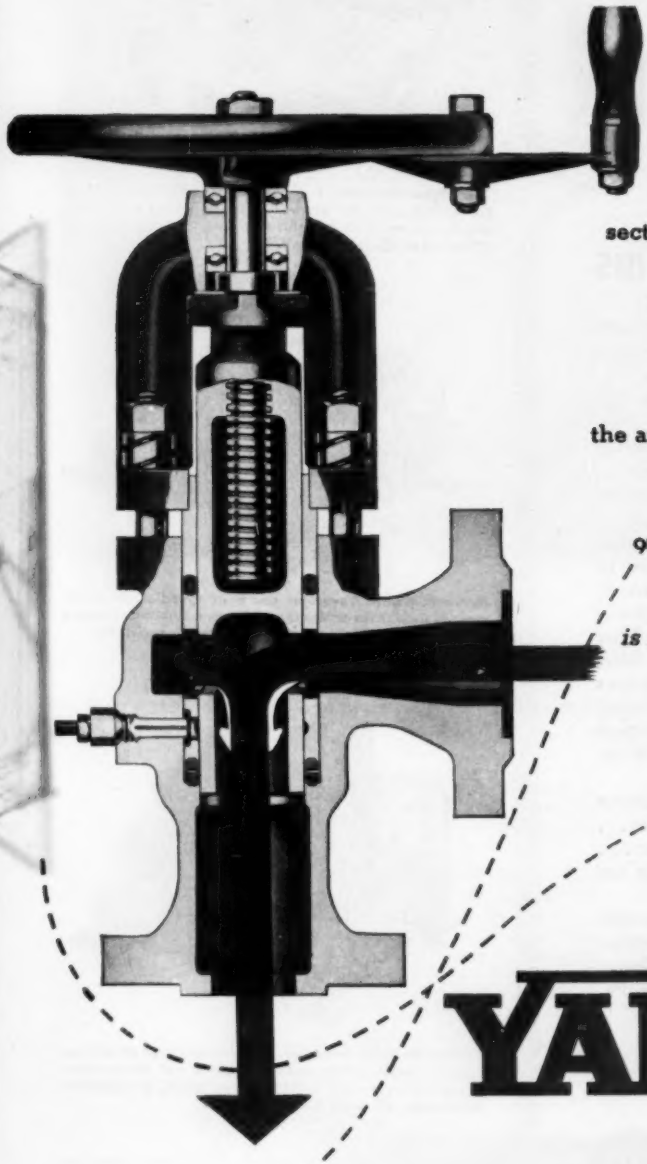
Hydraulic-Orifice Governor. For wide speed-range applications such as drives for fans, blowers, and compressors —*3-to-1 speed-adjustment range; 6% speed regulation.*



Vertical Oil-Relay Governor. For narrow-range precision-control applications such as drives for generators, pumps, blowers and compressors—*33⅓% speed-adjustment range; 4% speed regulation.*

J-50527

OPEN AND



Take a look at these two sectioned pictures of a Yarway Seatless Blow-Off Valve. They show the reasons why more than 15,000 boiler plants use Yarways.

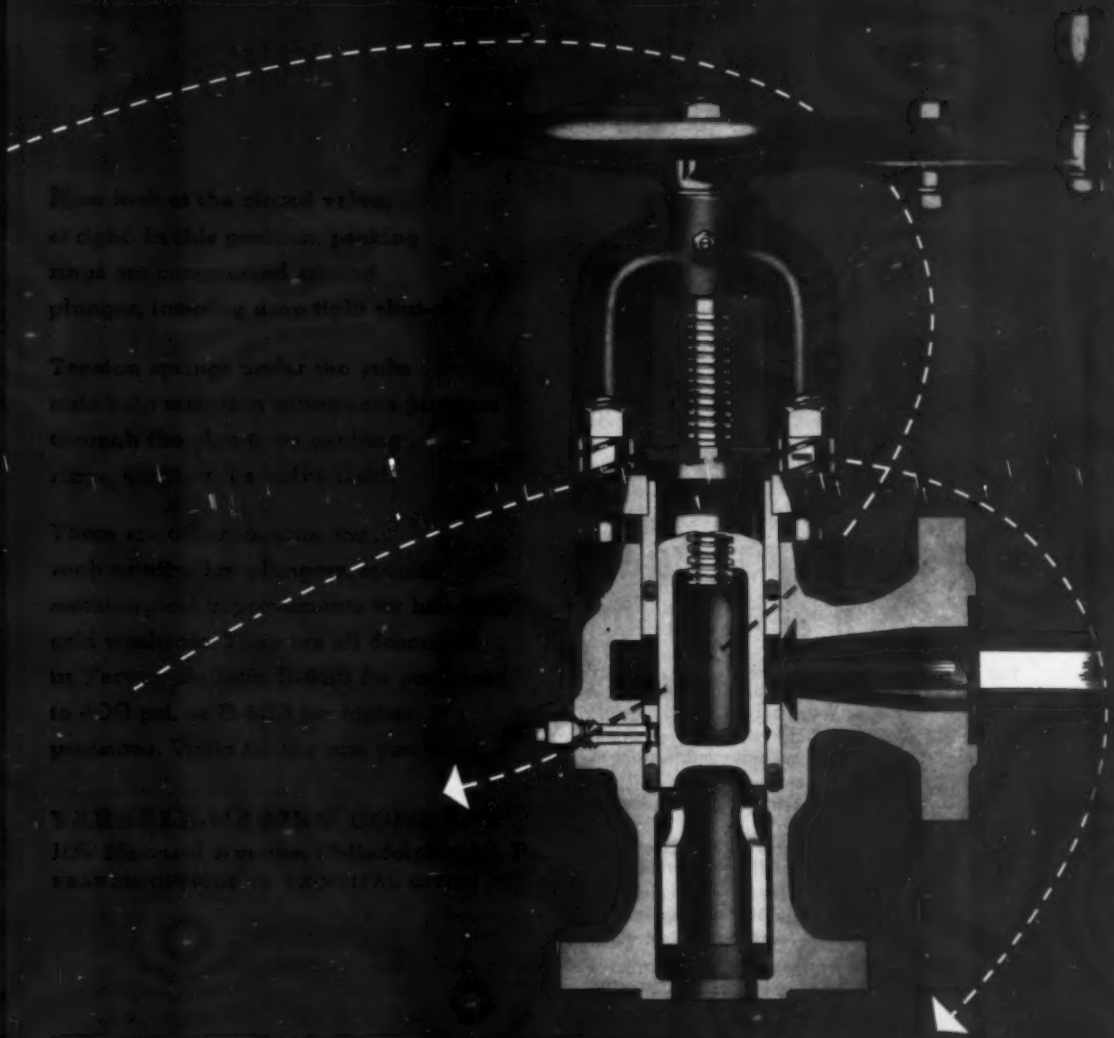
Notice in the open valve, at left, the ample space provided for free flow of blow-down through the hollow plunger. There are no projections or pockets to catch scale or sediment.

Notice particularly that *there is no seat to score, wear, clog or leak.* That most troublesome part of a blow-off valve has been eliminated!

YARWAY

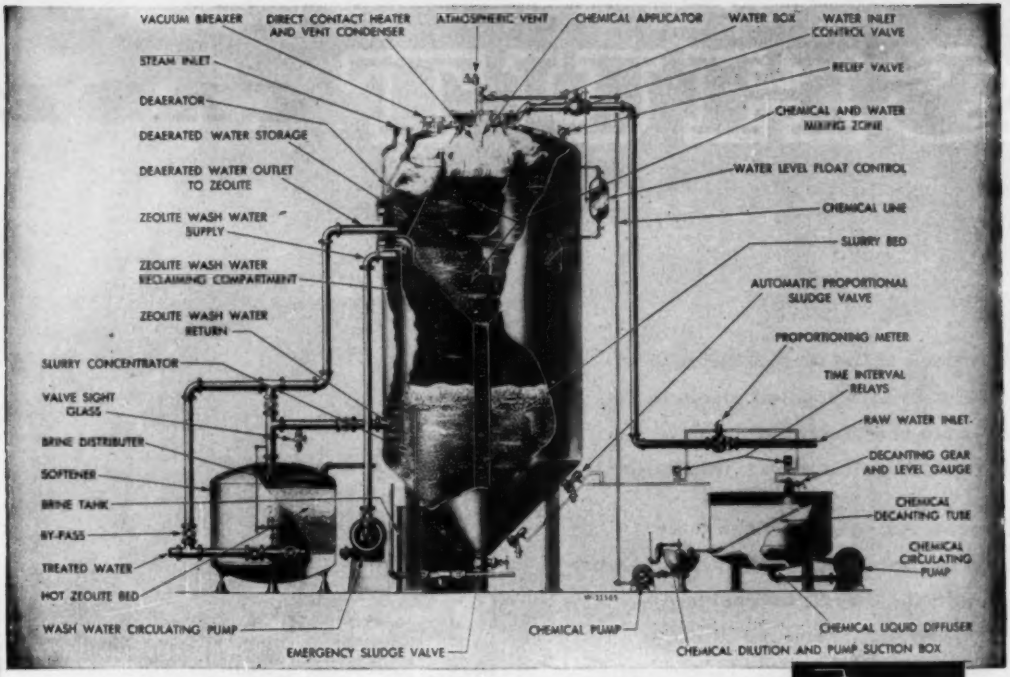
KEEP BOILERS ON THE

SHUT



BLOW-OFF VALVES

BY STOPPING BLOW-DOWN TROUBLES



Here's how to make water softening a soft job for you

You have less to do . . . to worry about . . . to pay for—when you use Worthington's revolutionary Hot-Z Slurry-Type Deaerating Water Softener.

It combines all the best features of Hot Process and Zeolite, plus these Worthington-originated features:

No more scaling trouble. Direct-contact vent condenser eliminates scaling trouble experienced with old-fashioned shell-and-tube types.

Supervision reduced. Concentrated sludge is removed automatically and proportionately to water volume.

Assures uniformity. Hydraulic chemical mixer assures uniformity of chemical strength. Also saves space.

Easier cleaning of valve-type wash water sight glass.

Better deaeration. Steam-jet deaeration is simpler, gives better efficiency—removes oxygen to .005 cc per litre.

Independent backwash system. Built-in annular wash water compartment provides clear hot water for backwashing and reclaims it without affecting operating velocities in treating zone. This feature not only pays off in systems employing filters, but also is ideal for backwashing the hot zeolite.

You also save because Worthington Hot-Z Systems operate on low-priced lime and salt. The average installation saves enough in chemical costs to pay for itself in 3 years!

Get all the facts!

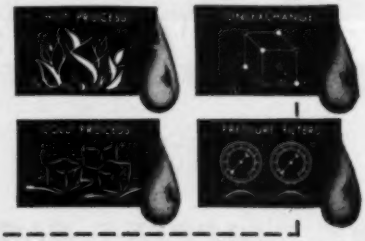
It will pay you to investigate the Worthington Hot-Z System thoroughly. Tell us your conditions of service and get our recommendation in terms of dollars and benefits. You'll find *there's more worth in Worthington.* Worthington Pump and Machinery Corporation, Water Treating Section, Dunnellen, N. J.

J3.2

WORTHINGTON

WATER CONDITIONING

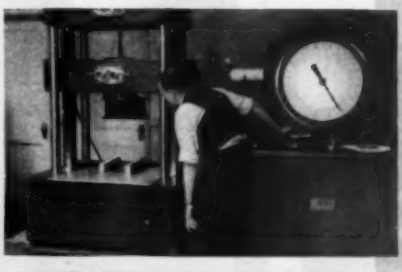
Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



Why Grinnell is America's #1 Supplier of PIPE HANGERS *and* SUPPORTS

GRINNELL, ALONE, MANUFACTURES A FULL LINE OF HANGERS AND SUPPORTS

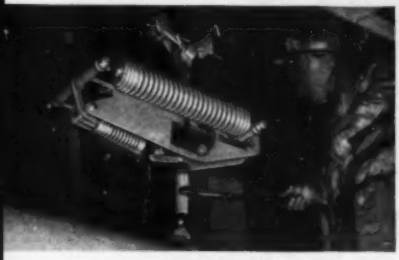
No other company, anywhere, makes a line as complete or varied. Grinnell produces hangers in thousands of combinations to support any piping.



GRINNELL, ALONE, MAINTAINS AN EXPERIENCED LABORATORY STAFF OF TRAINED TECHNICIANS

In its modern, well-equipped laboratory, tests are constantly being made to discover better ways of solving old and new pipe suspension problems.

Grinnell makes scientifically designed, ruggedly built pipe hangers and supports for every type installation.



GRINNELL, ALONE, PROVIDES ENGINEERING ASSISTANCE IN DESIGN AND INSTALLATION

Grinnell makes available specialized knowledge in the computation of hanger loads and the selection of the correct supports. Engineers in the field assist with problems in erection of pipe hangers.

GRINNELL, ALONE, THROUGH ITS CONVENIENT WAREHOUSES CAN SUPPLY YOU "OUT OF STOCK"

No manufacturer of pipe hangers offers a distribution system as thorough or efficient. Grinnell warehouses are located in 30 principal cities . . . with jobbers in practically every city, coast to coast.

Pipe suspension presents an extremely wide range of problems involving weights, stress, thermal movement, materials and specialized engineering. No one "goes into" the pipe hanger business overnight. Large manufacturing facilities, skilled technicians, and a lot of down-to-earth practical experience are needed.

Grinnell has become America's No. 1 supplier of pipe hangers and supports only because Grinnell has specialized in piping for one hundred years. Grinnell has developed a line of pipe hangers and supports for every piping requirement, from the simplest to the most complex.

Grinnell is always ready to co-operate with engineers and architects in the preparation of pipe suspension specifications.

Call Grinnell for any and all types of pipe hangers and supports.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Sales Offices and Warehouses in Principal Cities

pipe and tube fittings • welding fittings • engineered pipe hangers and supports
Thermolier unit heaters • valves • Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies • industrial supplies
Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

IT'S PACKED WITH SATISFACTION WHEN IT'S PACKED WITH **R/M**

You will find Raybestos-Manhattan packings and gaskets in machines like this reciprocating boiler-feed pump, and in practically every other type of fluid-handling equipment in industry. The long line of R/M packings and gaskets is relied on by experienced engineers, not only for pumps, but for valves, compressors, expansion joints, hydraulic rams, and wherever trouble-free service is essential. The R/M distributor near you will gladly help you select the right packing or gasket for your needs. Or write for the R/M Packing Catalog.

R/M **PACKINGS**

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Peterborough, Ontario, Canada

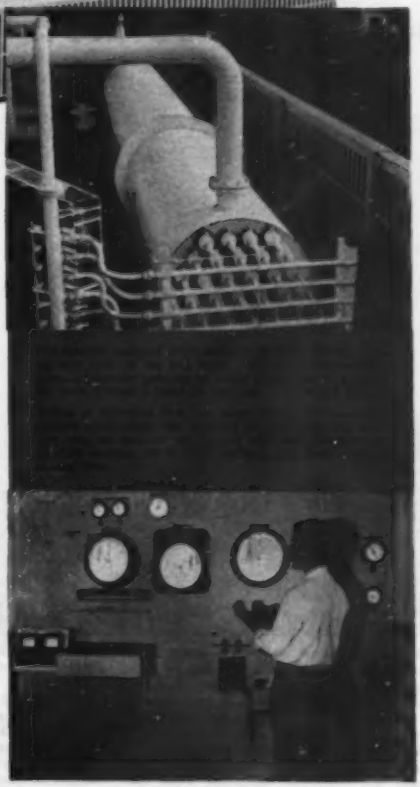
RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls

fluor's modern research facilities

test new developments — verify efficiency

At Fluor, the proof of the design is in the testing. *Before* new Cooling Tower developments are incorporated into standard design, they are subjected to rigorous tests in this modern, commercial-size tower testing laboratory. Here, design and performance efficiency of every new development is determined through complete ranges of actual heat transfer conditions. Realistic rating data is established under conditions *paralleling* those of plant and process operations.

Fluor Cooling Tower Testing Facilities. This commercial-size installation consists of a pump house, instrument house, 20,000,000 BTU/H boiler, test basin, and a 40' high test tower.



What this means to you . . .

The motivating power behind Fluor's continuous research and development program is to *always* provide the most efficient cooling tower available. This fact, combined with Fluor's 30 years of active experience in designing major cooling tower installations for the petroleum, chemical, and power industries, means many things to the man seeking a factual tower recommendation to meet his exact cooling requirements.

A Fluor Cooling Tower recommendation means that all variables are included and compensated for. It means that all component parts, as well as all design theory, have been tested and evaluated under actual operating conditions. And, it means that a Fluor-designed cooling tower will perform at *rated* heat transfer efficiency under the conditions of installed operation. *You can be sure with Fluor!*

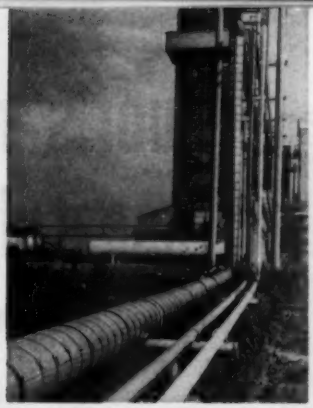
FLUOR

Designers - Engineers - Constructors - Manufacturers

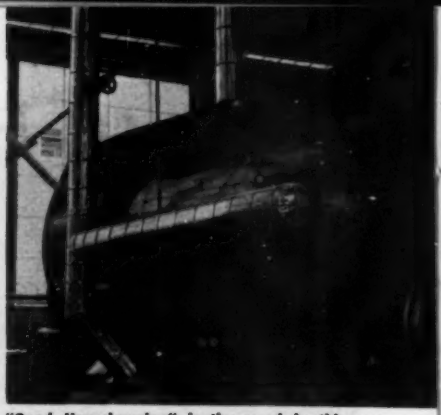
THE FLUOR CORPORATION, LTD., 2500 S. ATLANTIC BLVD., LOS ANGELES 22, CALIF.
New York, Chicago, Pittsburgh, Boston, Tulsa, Houston, San Francisco, Birmingham and Calgary

Represented in the Sterling area by:
Head Wrightson Processes Ltd., Teesdale House, Eaton Street, London, E.C.4., England

This big new Oklahoma refinery has used a new kind of aluminum jacketing throughout on both insulated lines and towers and vessels. Light in weight and low in cost, this new Childers Aluminum Jacketing cut installation costs. It is also expected to cut maintenance costs.



Childers Aluminum Jacketing is used here on a cross-country transfer line at a large chemical manufacturing plant in Texas. This is a rugged test for any jacketing, but the light-weight aluminum used in this jacketing should stand up to weather and chemical corrosion it encounters.



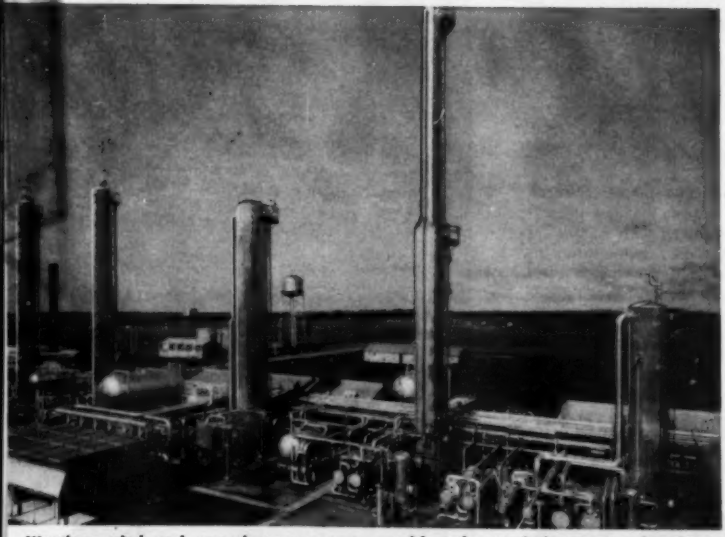
"Good Housekeeping" is the word in this gas pipeline pump station. The insulated lines are handsomely protected by Childers Aluminum Jacketing, which should last as long as the plant itself. The jacketing requires no painting and very little other maintenance. It even allows the interior of the plant to be washed with a hose without harm to the insulation. The chief engineer reports: "We have standardized on Childers Jacketing for all our insulated lines. It is doing an excellent job for us and saving us money."

How 5 plants cut costs of jacketing insulated lines

Weather-resistant, low-cost, easy to put on—these are big reasons for the growing popularity of a new jacketing, specially engineered for insulated lines. It is made of .006" thick aluminum and comes with or without a moisture barrier. It is called Childers Aluminum Weatherproof Jacketing. You can write for a free sample without obligation.

Address Childers Manufacturing Co., Dept. YP-3, 625 Yale St., Houston 7, Texas.

Under CMP regulations, Childers is a Class B product, the use of which is not restricted.



Weather, wind and corrosive gases are not going to attack the insulation of this new plains-country gasoline plant. The insulation is protected by long-lasting aluminum: Childers Aluminum Weatherproof Jacketing. The management expects this low-cost jacketing to hold insulation maintenance costs to a minimum. Other advantages are that the jacketing went on quick and easy during construction; it required no special tools or skill — no shop forming or cutting. It can be taken off and re-used if lines are moved. Aluminum saves on painting and the tough 3S alloy used for Childers Jacketing should stand up for years even in highly corrosive industrial atmospheres. Check the advantages of this jacketing for your own plant.

Amazingly easy to handle, Childers Jacketing was applied here by men using no more than a wooden wedge and a pair of pliers. Childers has engineering representatives in every major industrial center who will be glad to confer with you on your particular jacketing problems. Write to address shown above.

Advertisement

here's a complete WATER WORKS in a small package...

JBAS

for:

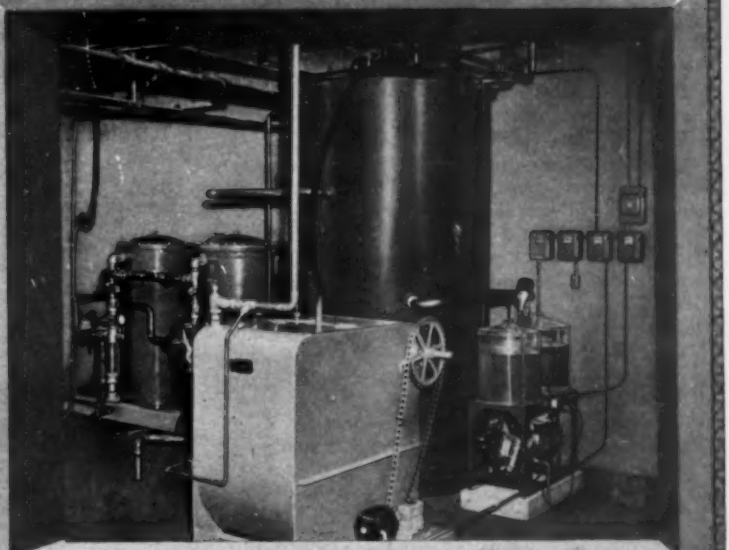
FIELD CREW DRINKING SUPPLY

ENGINE COOLING

BOILER FEED

SMALL DOMESTIC SUPPLIES

CHEMICAL AND MANUFACTURING PROCESS



FOR THE MANY USES OF TREATED WATER, INFILCO ENGINEERS THE JBAS ACCELATOR

The JBAS doesn't care if your source of water is creek, river, lake or well. It is equally effective for softening, clarifying, sterilizing, or removing organic matter, tastes, or odors. Its versatility has been demonstrated in hundreds of installations treating 5 to 100 gallons per minute, providing a water equal or superior to large municipal supplies.

Ask for Bulletin 1845

and see how a JBAS conserves space and installation costs. Learn how and why JBAS gives uniformly satisfactory results with minimum supervision and attention. Note it can be readily moved, too, if necessary.

INFILCO

BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894

INFILCO INC. *Tucson, Arizona* | *Plants in Chicago & Joliet, Illinois*

FIELD ENGINEERING OFFICES IN 26 PRINCIPAL CITIES

World's Leading Manufacturers of Water Conditioning and Waste Treating Equipment

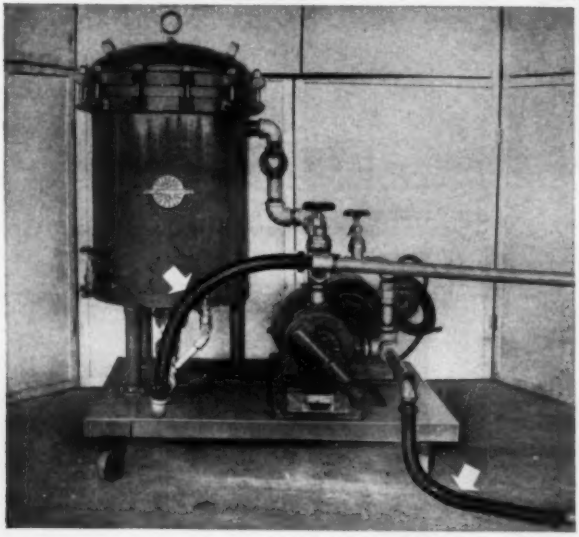
for products with piping that must **flex, bend** or **vibrate!**

These three products have only one thing in common—piping that moves, bends or vibrates. And for all three, there's a type of American Flexible Metal Hose or Seamless Flexible Metal Tubing to meet the need.

There's a type of versatile, flexible American Metal Hose to improve your product's performance . . . to convey liquids, gases or semisolids under severe conditions of temperature, pressure . . . to minimize vibration, to connect misaligned piping and ports. Let us send you Bulletins SS-50 and CC-300 with the full details. The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Company, Ltd. Distributors in all key cities.

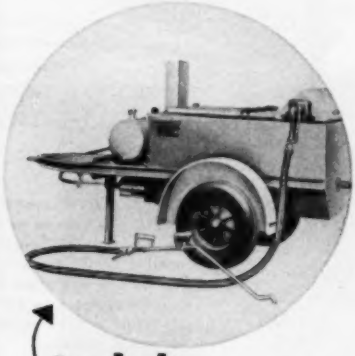
vapor steerer

American ⅝" I.D. Aluminum Flexible Metal Hose provides a convenient adjustable duct for directing heating vapor from this "Vapor All" Vaporizer Inhalator to where it is needed. It's tight, light, sanitary and rust proof. Courtesy Sanit-All Products Corporation, Greenwich, Ohio.



inlet-outlet

American 1" I.D. Steel Seamless Flexible Metal Tubing connects this filter made by the Sparkler Mfg. Co., Mundelein, Ill. at inlet and outlet, with rigid pipe leading to vat or other liquid container. Tight and strong, it makes connecting and disconnecting the unit quick and easy—minimizes vibration while in operation.



tar baby

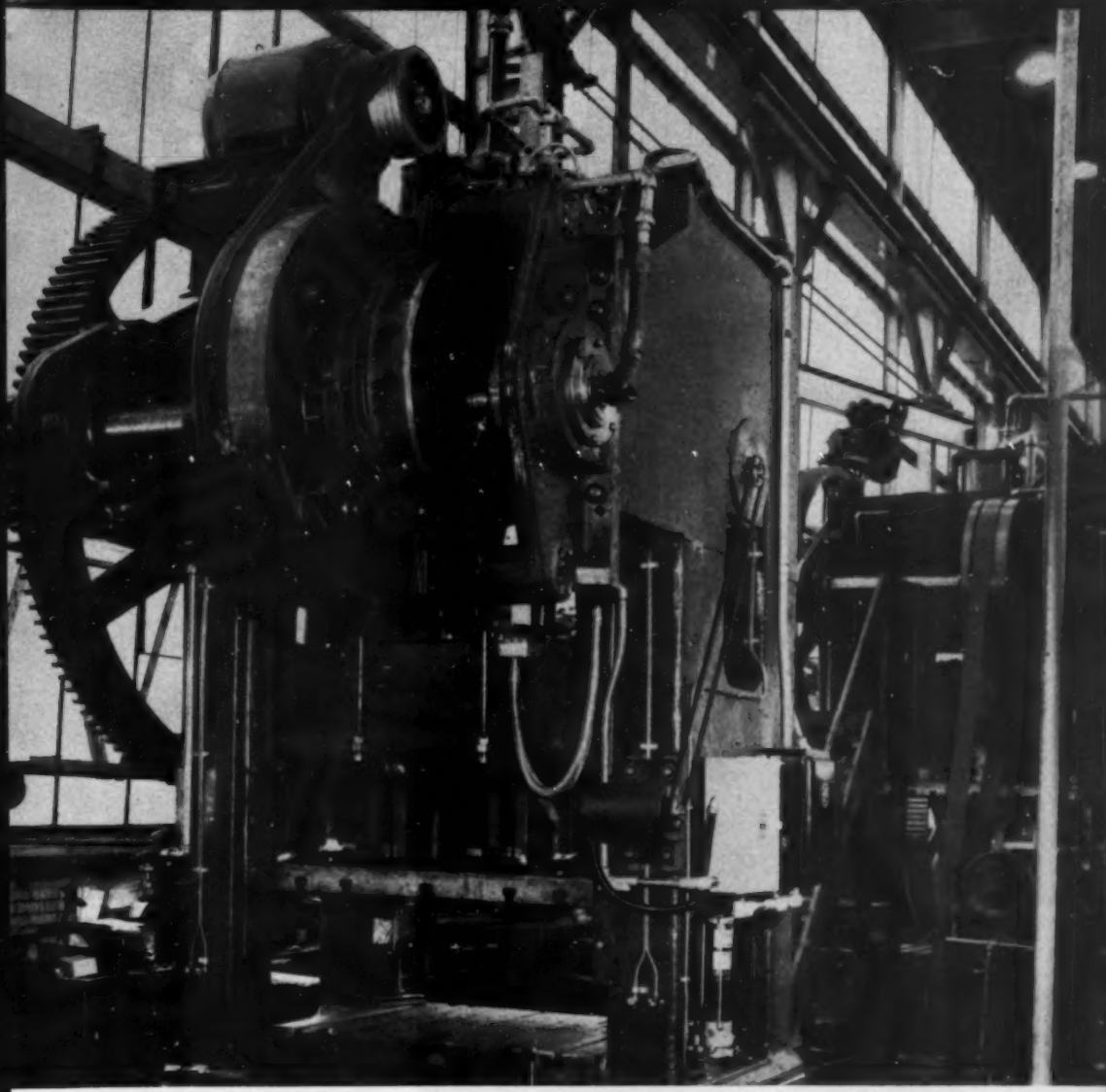
Pouring hot tar for roadway repairs is usually a slow and messy procedure—except when you do it this way with a mobile tar kettle such as this made by Littleford Bros. of Cincinnati, Ohio. Here the tar is dispensed by pump through a 1" I.D. armored and insulated American Flexible Tar and Asphalt Hose connected to a nozzle. It's a good example of the versatility of American Flexible Metal Hose and Tubing in handling almost anything that flows.

wherever connectors must move . . .

American ANACONDA

FLEXIBLE METAL HOSE AND TUBING

B.F.Goodrich GROMMET BELTS AT WORK

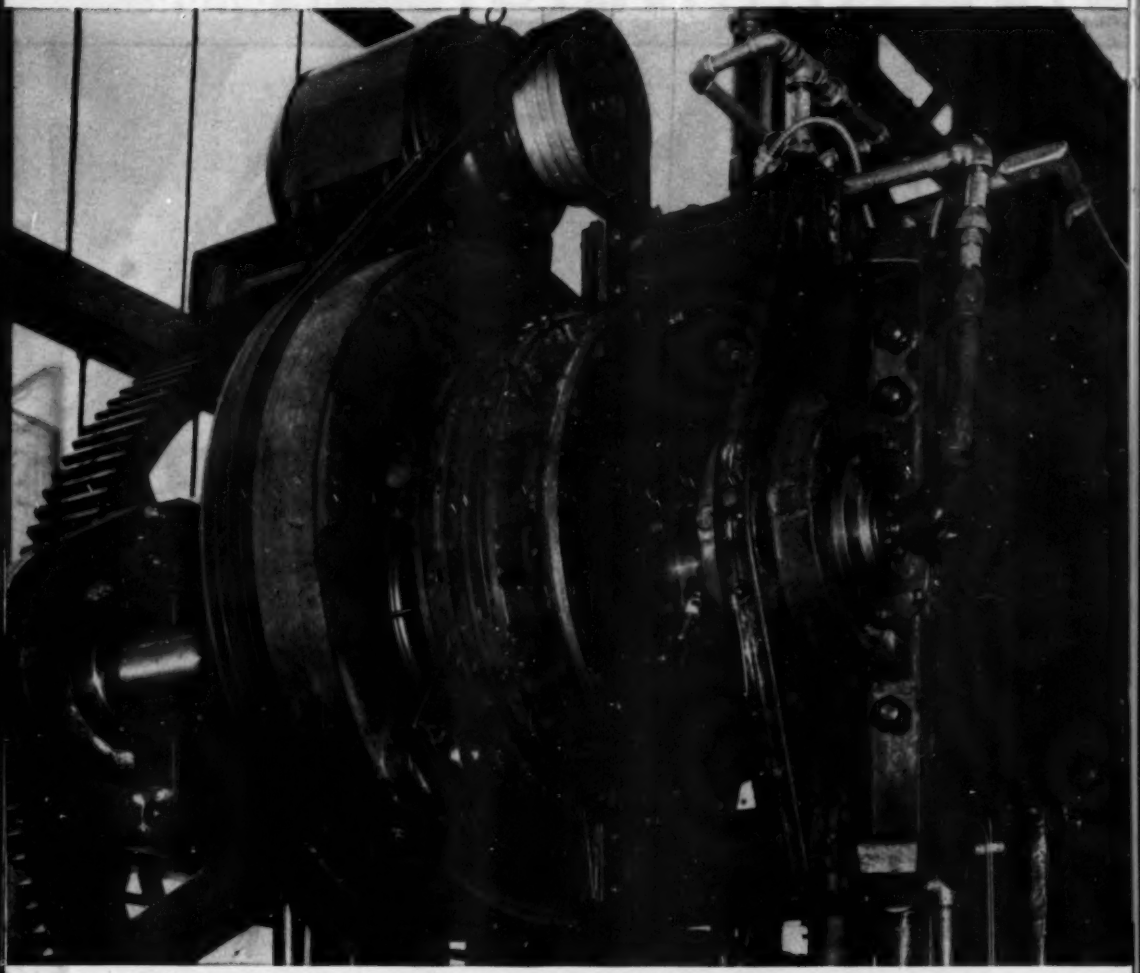


Two hundred tons of force and iron are walloped down on unshaped metal to make a refrigerator door or hub cap for a car.

Iron fist with 200-ton punch

Metal things you see every day take shape on a giant press like this. The four rubber V belts at the top give the press its punch. But when they ran at full speed, shocks from the press made ordinary V belts go to pieces in a few days. Then part of the press had to be taken apart to install new belts. It took an entirely different kind of belt to solve this problem—as shown on the following pages.

200-ton punch (continued)



Repeated wallops—sometimes 15 punches a minute—caused frequent knockouts to ordinary belts on E. W. Bliss Co. presses.

To solve the problem described on the preceding page, the press maker called in B. F. Goodrich men. What about the grommet V belt? It had been developed by B. F. Goodrich to give belt users more wear for their money. Could grommet belts stand the shocks on the big presses? They began using this different kind of V belt and found it not only took the punishment longer but did a better job of running the press too. Here's why:

20 to 50% Longer Life

Patented grommet V belts by B. F. Goodrich represent the only basic improvement since invention of the V

belt. Belts last 20 to 50% longer, depending on service. (The more severe the service the greater the increase over ordinary belts.)

What is a Grommet?

A grommet is like a giant cable except that it's endless—a cord loop built up by winding heavy cord on itself. There is no overlapping cord *section* as in all ordinary belts. Most belt failures occur in these sections where cords overlap!

All Cords Put to Work

Each grommet and every part of a grommet carries its share of the load. In ordinary belts under high tension the center cords "dish" because tension is greater near the driving faces. Dished cords are doing less work, not pulling their share. There are no cords in the center of grommet V belts, there is no dishing—therefore much more strength in proportion to cord volume.

Better Grip, Less Slip

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor. Because there is less slip there is also less surface wear.

They Cost No More

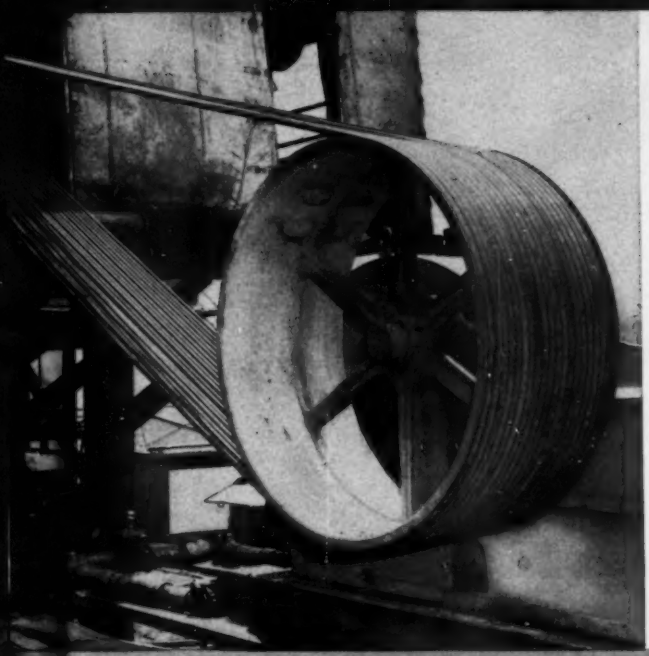
You save belt costs because belts last longer, save production costs because machines keep running with fewer interruptions, save maintenance costs because they need less attention, yet cost not one cent more than others. Grommet belts are made in C, D and E sections. They are patented by B. F. Goodrich. No other V belt is a grommet belt (U.S. Patent Number 2,233,294).

Flying belts grounded..

Ordinary V belts used to snap in two, fly off this drive in only four months. Then a B. F. Goodrich man suggested replacing the short-lived belts with BFG grommet belts. A set of grommet belts, installed in September 1950, has already lasted three times as long as previous belts, still looks good, and is saving over $250 a year in replacement costs for the Lydall and Foulds Paper Company, Manchester, Connecticut.

Belts are saving over $250 a year in replacement costs in this paper plant.

B.F.Goodrich GROMMET BELTS AT WORK



Double life

These 19 V belts are needed to drive a heavy pump for drilling oil wells. Ordinary belts couldn't stand the pulling load, couldn't take the strain of round-the-clock operation. They averaged 9 months' life in this kind of service.

Then B. F. Goodrich grommet belts were tried. After 19 months, and drilling wells totaling 76,000 feet deep, these grommet belts look as good today as the day they were installed, and are saving $104.50 a month in replacement costs.

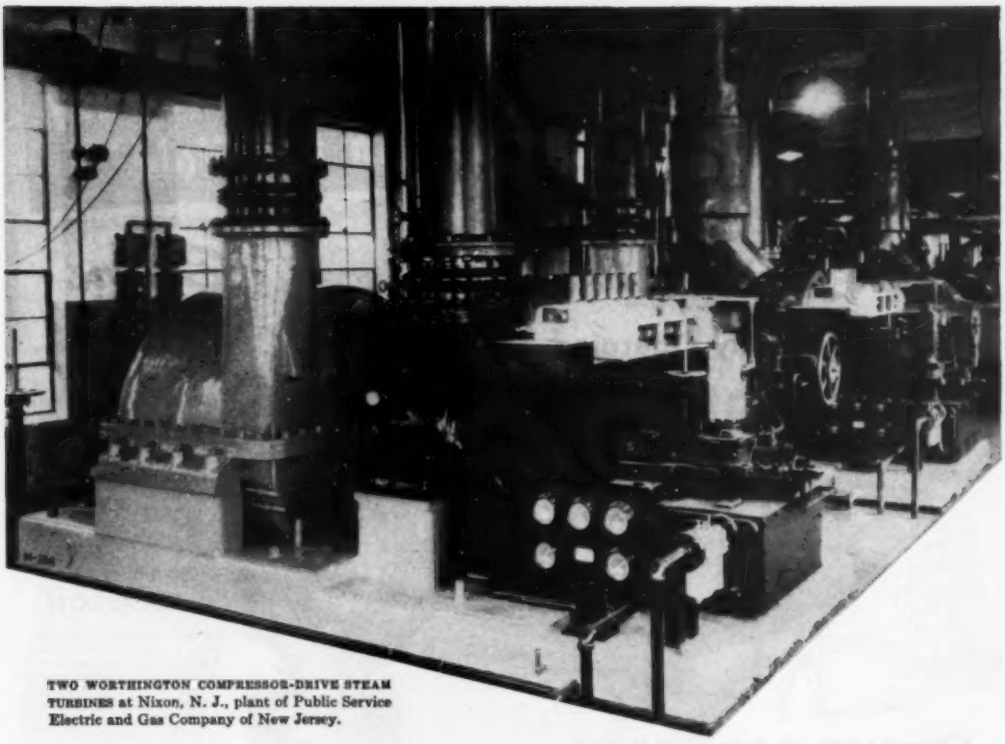
The grommet V belt is a typical B. F. Goodrich improvement—an improvement that saves money, does jobs better for industries of all kinds. Good reasons why it will pay you to get in touch with your B. F. Goodrich distributor when you need V belts.

These belts operate 24 hours a day, 7 days a week, in all sorts of weather.

These typical examples tell you why B. F. Goodrich grommet belts are superior to ordinary V belts. They prove that grommet belts last 20 to 50% longer than other types—yet cost no more.

Grommet V Belts BY
B.F.Goodrich
FIRST IN RUBBER

The B. F. Goodrich Company, Industrial Products Division, Akron, Ohio



TWO WORTHINGTON COMPRESSOR-DRIVE STEAM TURBINES at Nixon, N. J., plant of Public Service Electric and Gas Company of New Jersey.

Over 30 Worthington compressor-drive turbines serve Public Service of New Jersey

In a business where "service" is always the first consideration, Public Service of New Jersey has picked a long-service performer—the Worthington Steam Turbine—over thirty times, for installations from Jersey City to Trenton.

Public Service of N. J., like many other Worthington users, know that the biggest secret behind the Worthington turbines' service reliability lies in *engineering*—Worthington's ability to design a steam turbine to fit any mechanical drive. And that engineering ability is backed by experience in thousands of installations of all types and sizes—*the broadest experience you can find in compressor-drive engineering.*

Worthington builds compressor-drive turbines —all types and sizes—up to 25,000 hp. A wide variety of governors fits them for all operating conditions. Write for bulletins to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.

T.1.6

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbines

The ADVANTAGES of *Automatic Operation* are Now Available to Manually Operated DIAMOND G9B SOOT BLOWERS

Conversion is Easy in the Field

MANUAL OPERATION

Operator opens valve in steam line . . . then pulls the chain that opens and closes the valve in head and simultaneously rotates the element. His time and attention are required throughout operation.

AUTOMATIC OPERATION

The operator simply opens a valve . . . the automatic air control then takes over and assures correct cleaning every time.

By means of a simple field change and the addition of power air, any manually operated Diamond Model G9B Soot Blower can be converted to automatic (air) operation. The sheave wheel, chain guide and chain of the manually operated blower are removed and replaced by the air control assembly and gear guard as shown at the right.

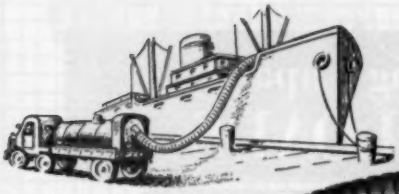
The converted G9B blower is set in operation simply by opening a valve at the blower; the unit then automatically goes through the preselected blowing cycle and stops. The valve is then closed manually. By addition of a control panel, full automatic SEQUENTIAL blowing is available.

The Diamond Model G9B is the most widely used of all soot blowers. This permanently installed (multi-nozzle element) steam blower of proven dependability has numerous outstanding features. Included are cam and trigger valve operation, flexible element connection and adjustable pressure control. To these can now be added the many advantages of automatic or automatic sequential operation at moderate cost. Conversion takes little time in the actual changeover, and the blowers are not removed from the boiler wall. Get in touch with the nearest Diamond office for further information or write directly to us at Lancaster, Ohio.

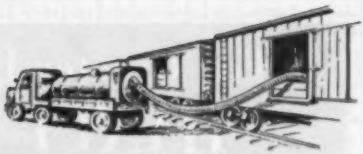
DIAMOND POWER SPECIALTY CORP.
Lancaster, Ohio
Diamond Specialty Limited • Windsor, Ontario

Diamond Short Retracting and Long Retracting Soot Blowers that are Manually Operated also can be Converted to Automatic Operation in the Field. • WRITE FOR INFORMATION.

4296



SHIP UNLOADING



GRAIN UNLOADING

INSULATION BLOWING

ASH REMOVAL

PENFLEX TAKES THE BITE OUT OF SHARP-TOOTHED CARGOES

PENFLEX FLEXIBLE TUBING MOVES ABRASIVE COPRA—PROVIDES SMOOTH-FLOWING, FLEXIBLE TRANSMISSION —RUGGED RESISTANCE TO WEAR

Unloading abrasive copra is a tough ship-to-shore operation which often spells quick death for conveyor tubing. Jagged chunks of copra eat away ordinary metal tubing—tear rubber hose to shreds.

Wherever "smooth throat" Penflex tubing is on the job, roughest cargoes go down easily. Penflex tubing—tough, smooth and flexible—flows roughest materials evenly . . . eliminates costly clogging and stoppages. And Penflex means flexibility too. Hose moves freely in the hold, absorbs vibration from machines, takes up movement of the ship due to tide changes.

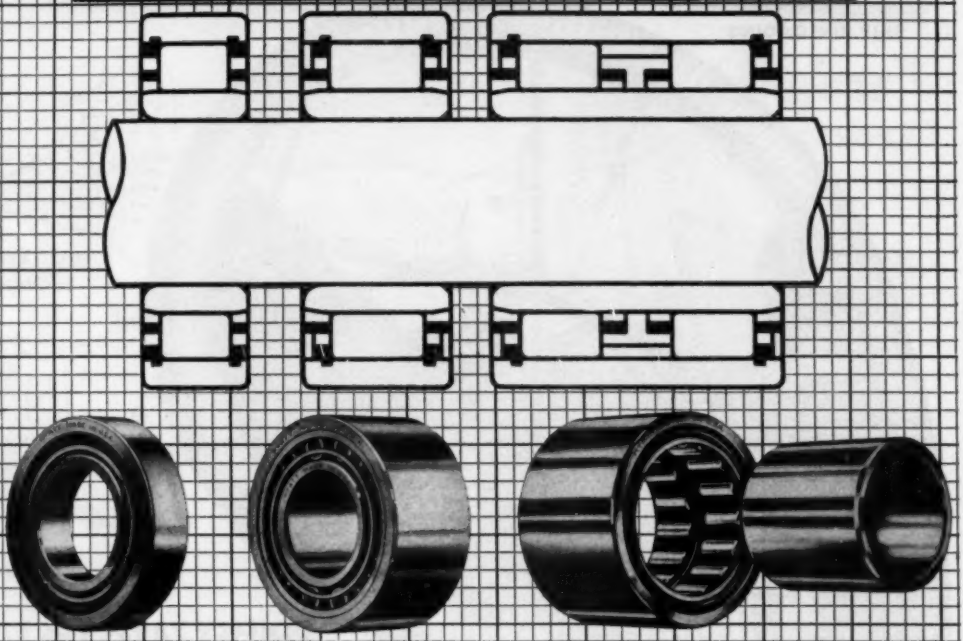
For help with all your tough tubing problems, just call in your Penflex engineer. Penflex makes a complete line of four-wall, interlocked and seamless welded corrugated tubing—from ⅛" I.D. up ...automatic barrel fillers, accessories, fittings, and pneumatic rivet passers. Write for illustrated folder "Flexineering," containing valuable flexible tubing data for your particular product application.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7238 Powers Lane, Phila. 42, Pa.
Branch Sales Offices: **Boston • New York • Chicago • Houston • Cleveland • Los Angeles**

penflex

HEART OF INDUSTRY'S LIFE LINES

For Greater Bearing Capacity—
HYATT HY-LOADS



A-1200-TS Narrow Series

A-5200-TS Wide Series

A-6200-TS Duplex Series

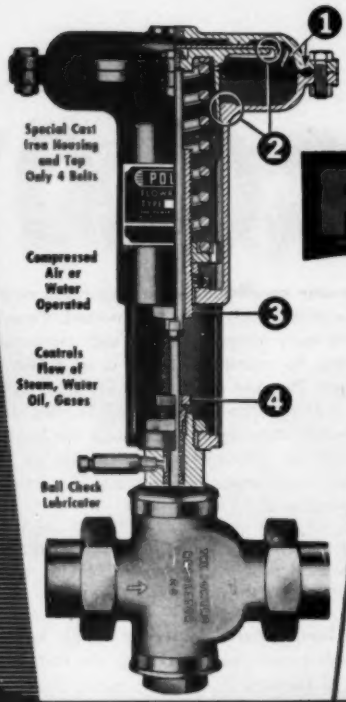
Where bearing overall dimensions must be kept to a minimum, Hyatt Hy-Load Light Series Roller Bearings are available in three widths to satisfy load requirements and permit wide design range.

As greater load-carrying capacity or longer bearing life is required for a given shaft size and bore diameter, you can go progressively from the narrow, to the wide, or to the duplex series of Hyatt Hy-Load Bearings as illustrated.

When operating speeds are relatively low, greater radial capacity can be obtained in limited space with Hyatt Hy-Loads of the full complement type. In this type of bearing, available in both wide and narrow widths, the roller separators are eliminated, and the maximum number of rollers are employed to provide increased capacity within the same boundary dimensions.

Write for a copy of catalog 547 . . . a complete guide to the selection and use of radial roller bearings. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS



POWERS **FLOWRITE** VALVE

LVE TOP—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment.

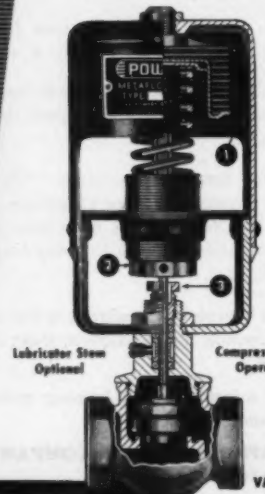
ADJUSTING SCREW—Ball bearing non-rising type. Easily accessible, 180° turning radius with starting pressure adjustable from 0 to 17 psi. Has enclosed rust proofed steel spring for full travel in 5 or 10 psi. control pressure change.

BONNET ASSEMBLY—Polished stainless steel stem in preformed lubricated metallic packing insures long life and low hysteresis.

VARIETY of VALVE BODIES — Sizes ½" thru 8"—For line pressures below 250 psi. Rugged construction to withstand piping strains. Single seat or double seat, bronze and stainless steel trim. Double unions and flanged ends. Available normally open (direct acting) or normally closed (reverse acting) and 3-way type valves.

POWERS BETTER Valve Tops

Packless Valves Available



POWERS **METAFLOW** VALVE

VALVE SIZES— ½" thru 2"

Bronze bodies, screwed ends. Rugged construction to withstand piping strains.

POWERS *Metaflow Valves* are small, sturdy, light-weight, reasonably priced, suitable for many control applications where the pressure differential does not exceed 75 lbs. per square inch.

1. **HOUSING**—High strength aluminum alloy. Hydraulically formed long life brass bellows provides smooth and powerful stroke.

2. **ADJUSTING SCREW**—Brass with rust proofed steel spring having 15 lbs. adjustment range to give proper sequence operation where required.

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METAFLOW NO-PAK VALVES prevent leakage of inflammable or harmful liquids or gases and provide vacuum protection. Are suitable for use with Freon, oil, gasoline, non-corrosive gases, hot or cold water and low pressure steam.

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Introducing A NEW MEMBER OF THE INCO FAMILY INCOLOY

Incoloy is a wrought nickel-chromium-iron alloy, developed as a nickel-saving companion to Inconel. It is a high temperature material with good resistance to oxidation, strength at elevated temperatures and workability comparable to that of Inconel.

The principal engineering characteristics of Incoloy are:

- **Oxidation Resistance** – the oxidation resistance of Incoloy is of the same order as Inconel. It has a chromium content of 21%.

INCOLOY
Mechanical Property Ranges of Standard Forms at Room Temperature

Form & Condition	Tensile Properties. Tensile Strength 1000 psi.	Yield Strength (0.2% Offset) 1000 psi.	Elongation in 2 in. per cent	Hardness. Brinell 3000 kg.	Rockwell
Rod and Bar					
Cold-drawn					
Annealed	75-100	30-55	50-30	120-170	66-86B
As-drawn	100-150	80-125	30-10	180-290	908-30C
Hot-Rolled					
Annealed	75-100	30-55	50-30	120-170	66-86B
As-rolled	80-120	35-90	50-25	135-220	74-96B
Forged	80-120	35-90	50-25	135-220	74-96B
Wire					
Cold-drawn					
Annealed	75-105	25-55	50-25	.....	.....
Plate					
Hot-rolled					
Annealed	75-105	30-55	50-30	120-180	.....
As-rolled	80-120	35-90	50-25	135-220	.....
Sheet					
Cold-rolled					
Annealed	75-100	30-55	50-30	.....	88B (max)
Deep drawing and spinning quality	75-100	30-45	55-35	.....	80B (max)
Strip					
Cold-rolled					
Annealed	75-100	30-50	50-30	.....	84B (max)
Deep drawing and spinning quality	75-100	30-45	55-35	.....	80B (max)
Tubing					
Cold-drawn					
Annealed	75-100	30-55	50-30	.....	88B (max)

- **Expansion co-efficients**—The expansion co-efficients are approximately those for Inconel. Thus Incoloy should have about the same high temperature resistance to cracking under drastic temperature changes. Because of its relatively high nickel content (34%) the structure of Incoloy is stably austenitic showing no tendency to become embrittled by precipitation of sigma or carbidic phases after prolonged exposure to intermediate temperatures.

- **Room temperature properties** – Room temperature mechanical property ranges of Incoloy mill forms are shown in the table on the left:

- **High Temperature Properties** – High temperature strength properties of Incoloy are comparable to those of Inconel.

In terms of behavior in various high temperature environments it is anticipated that Incoloy will be superior to Inconel in resistance to sulfidation, green-rot and molten cyanide salts. Incoloy is comparable to Inconel in resistance to oxidation.

- **Work Hardening**—The rates of work hardening of Incoloy and Inconel are practically identical.

- **Annealing** – Annealing temperatures for Incoloy should be within the range of 1800° F. to 2000° F.

- **Fabrication**—Incoloy is workable, both hot and cold. It is machinable, though high-speed steel tools should be used.

- **Welding** – For metal arc welding, "132" Inconel electrode is recommended for all gauges. For inert gas metal arc, "62" Inconel filler wire is recommended. Sheet or strip up to ¼" may be joined by this method.

Forms supplied – Incoloy is produced in the usual mill forms – billets, rounds, flats, hexagons, sheet and strip, tubing and wire.

For additional information on Incoloy write to our Mr. R. F. Johnson.

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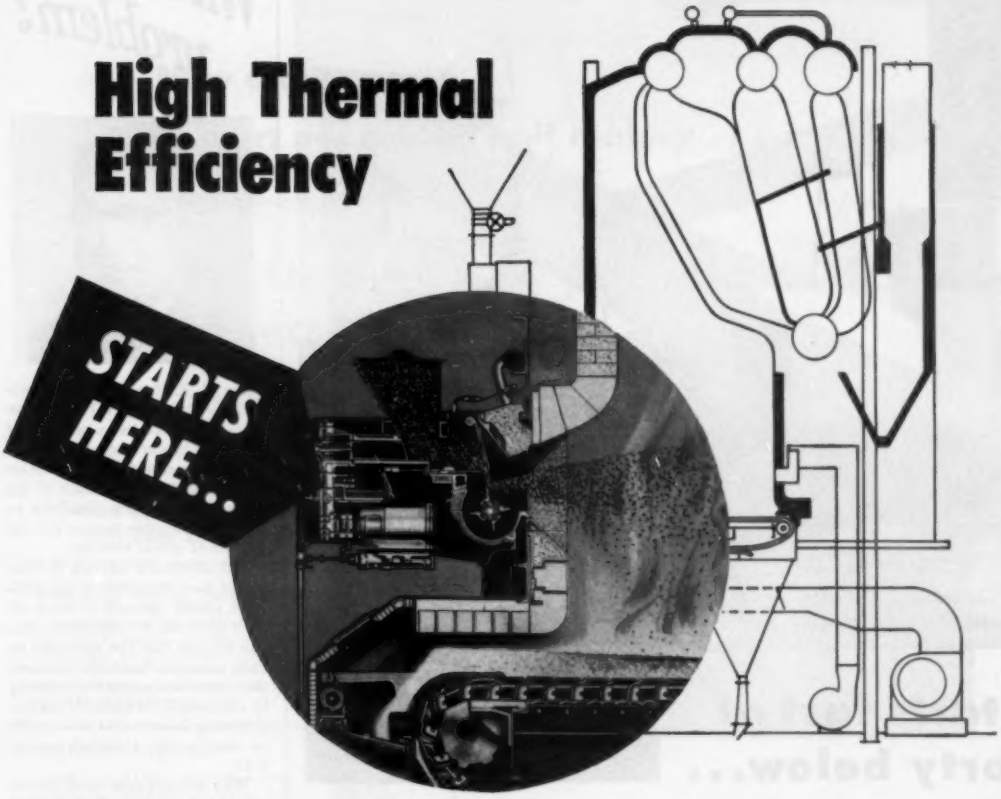
INCONEL® • INCONEL "X"® • INCOLOY® • NIMONICS

High Thermal Efficiency



It pays to choose your stoker carefully!

The coal-burning efficiency of your stoker is the starting point of coal saving . . . because the coal is all burned by the stoker and the coal bill is your major operating expense.

The burning of fuel for steam generation has always been one of the most exacting jobs that a machine can be called upon to perform. A stoker must operate twenty-four hours a day, seven days a week, for periods of six months or a year without a shutdown. The interior parts are exposed to heat and corrosion, the exterior mechanism to dirt and dust. A forced shutdown of the stoker may mean curtailment of production and cost the user many times the price of the stoker.

For over 60 years Westinghouse has maintained a consistently high standard of performance, while developing ever improved stokers to keep pace with the increasing demands of industry. And to make this assurance doubly sure, Westinghouse maintains a staff of experienced combustion engineers in all principal cities to make periodic inspections and give prompt attention to any operating problems.

Before you invest, be satisfied you are buying the best stoker. Westinghouse offers a complete line of underfeed and spreader stokers for use with any boiler of your choice. Capacities range from moderate to over 400,000 lbs. of steam per hour. Get the full story. Call your nearby Westinghouse office . . . or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50523

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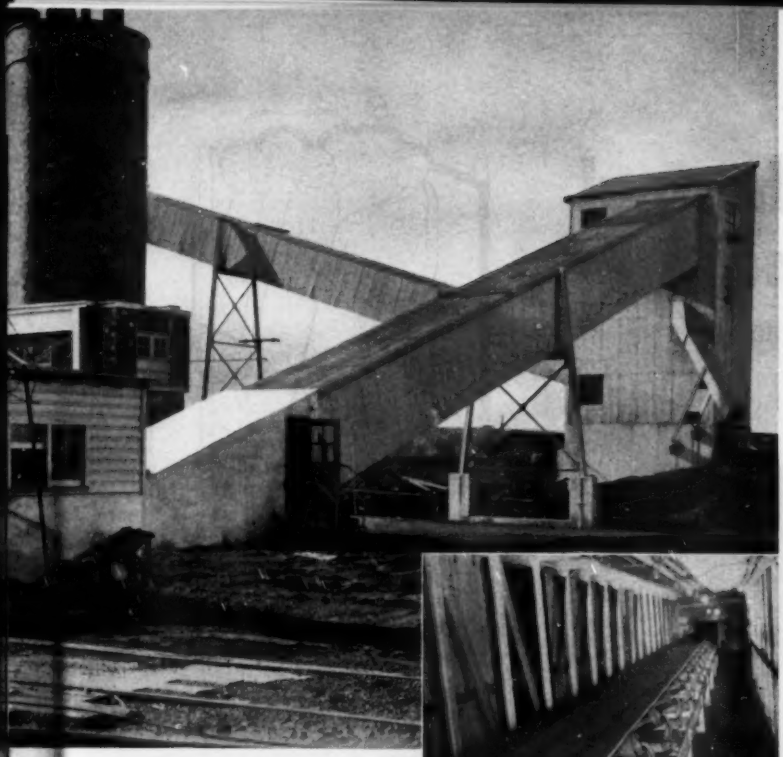

Starts fast at forty below...

This belt conveyor carries coal from railroad cars to overhead hoppers for a power company located in the northern part of the Midwest . . . so far north that temperatures frequently hit forty below zero. Starting the conveyor in that kind of weather meant lost time, wasted manpower. The bearing lubricant became so stiff that five or six men often were required to pull on the belt. Three hours a day frequently were lost in getting the unit in operation.

As many as a dozen conventional lubricants were tried without success before a change to STANOLITH Grease No. 42 was made on the recommendation of a Standard Oil lubrication specialist. None could match the ability of STANOLITH to provide easy starting at extreme low temperatures, and still maintain effective lubrication during high summer temperatures.

STANOLITH Greases are filling the bill in a wide range of industrial and processing applications because of their resistance to heat and to the washing action of water, and their ability to flow readily under wide variations in temperature. A Standard Oil lubrication specialist can help you take advantage of these special properties. A call to your local Standard Oil Company office is all that's necessary. Or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANOLITH
TRADE MARK
Greases

What's your problem?

Meet R. R. Rowlands, of Standard's La Crosse office. He is the lubrication specialist who worked with this power company to find the right grease for an especially tough job. And as a result of his work, the company was able to save considerable time in the operation of a coal conveyor.

His on-the-job service is typical of that available to all midwest plants through a corps of such lubrication specialists. You can be sure that the specialist in your own area has both the practical experience and the training in a Standard Oil Lubrication Engineering School that will result in dependable, thorough assistance.

Why not call your local Standard Oil Company office today? Put a lubrication specialist to work on your problem now. When he calls, be sure to discuss the advantages and performance records of these outstanding products:

STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in air compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

CALUMET Viscous Lubricants—These greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of open gears and chains, better internal lubrication of wire ropes.

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Sales operations are divided into four logical divisions

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Corrugated and convoluted flexible metal hose, machine tool conduit, refrigeration conduit, "Vibra-Sorber" vibration eliminators for piping, and assemblies for specific applications.

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Stainless steel aircraft components including hose of all types, bellows, oil and fuel lines, air lines, ducting and connectors of all types and many special assemblies for jet aircraft.

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Standard corrugated packless type expansion joints in free-flexing and controlled-flexing construction, high pressure Flexoniflex expansion joints, heat riser expansion joints, and special joints.

• In 1947, Chicago Metal Hose Corporation introduced to industry a new science—the science of Flexonics. It is defined as the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion. This definition so well describes our operations and the expanding range of our products that we are adopting it as our corporate name coincident with our 50th anniversary year.

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Other reasons—small size, easy installation, good for all pressures, only one moving part, low maintenance, low price.

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FREE OFFER. Don't take our word for it. Test Yarway's advantages in your own plant, without cost or obligation. Drop us a card or letter—a trial trap will be delivered promptly.

YARWAY the steam trap

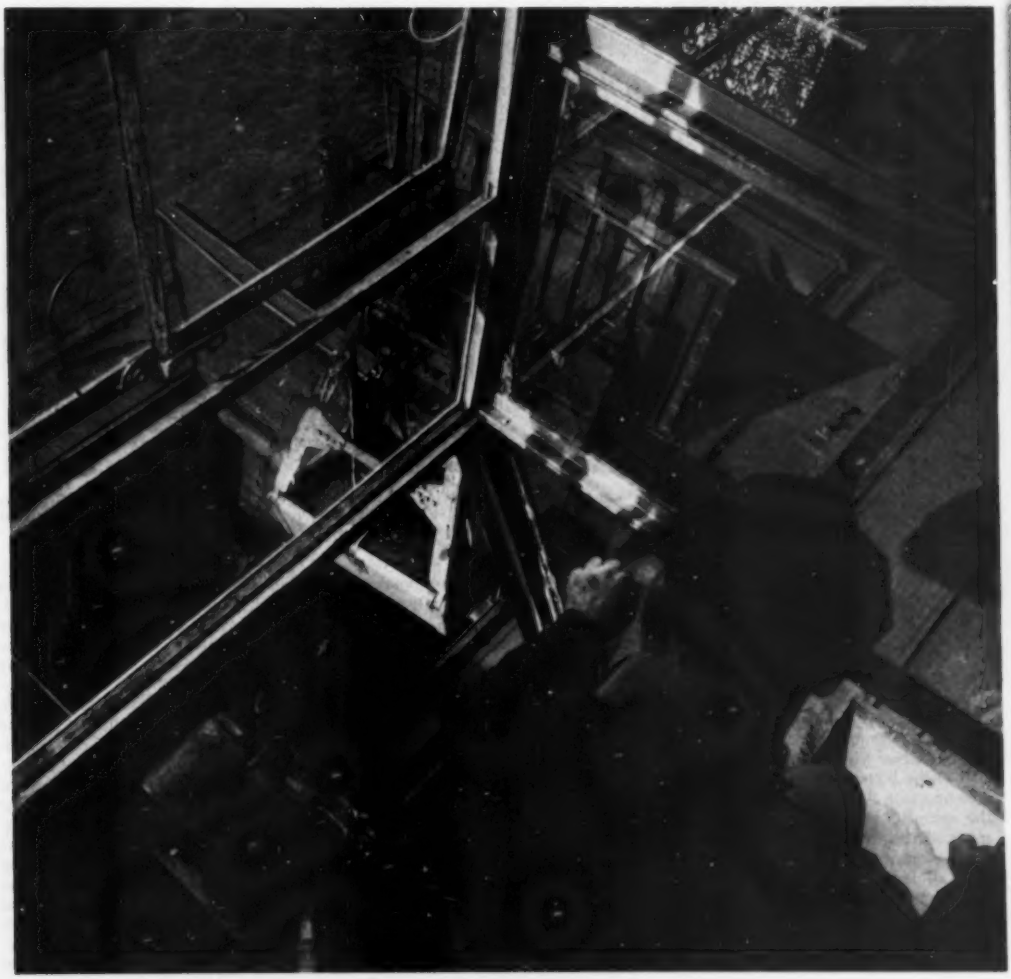
designed with more production in mind

MODERN SYSTEM MOVES 600 TON OF COAL PER HOUR

Ultra modern coal handling equipment, recently erected at the Camden Coke Plant of Public Service Electric and Gas Co. (NJ), has capacity to unload 600 ton of coal per hr. A 400 ft dock runway minimizes ship unloading time. Automatic dumping controls are used

E. L. BLANKENBEKER, *Heyl and Patterson, Inc.*
C. B. RISLER, *Westinghouse Electric Corp.*

Bird's-eye view from operator's cab shows loaded bucket coming from ship hatch. Cab can be moved out over the ship to greatly increase the operator's view of the bucket and hatch



Hoisting machinery is located in room at upper right. Operators cab is mounted on a telescoping boom and may be extended out over ship for better vision. Boom can be swung through a 270 deg arc to reach all points of ship and bins

A NEW movable coal unloading tower, handling a five-ton bucket on a thirty-second cycle, gives a free-digging rate of 600 ton of coal per hr at the 400-ft marginal dock of the Camden Coke Plant of the Public Service Electric and Gas Co. (New Jersey). This dock was constructed over 32 ft of water to accommodate and discharge large sized vessels. It was built to replace an obsolete inclined coal bridge built in 1902.

Features of this unloading tower include: 1. location of the operator's cab adjustable for maximum visibility, 2. automatic dumping of coal into hopper, 3. a-c rail clamp drives with d-c dynamic braking and 4. simplified drives for tower travel and apron hoist.

Coal from the tower is delivered to a longitudinal belt running the full 400-ft length of the dock. This belt delivers coal to a cross belt, which feeds a coal stacker with a boom having a swing of 270 deg. From here coal is delivered to a stock pile, to railroad cars, or to two track hoppers that feed coal to a conveyer leading to the oven coal bin. Two rubber-tired pieces of equipment are used in stocking and recovering coal from stock.

Tower traveling gear showing one of four gearmotors with motor mounted disc brake. Rail clamps, located midway between trucks, are operated by cables from upper level

Maneuverability

Tower movement is possible to all hatches of even the largest coal barges anchored at the dock. Each corner of the tower is supported on flanged wheels, with its own motor drive. Power-released, gravity-setting rail clamps on each of the two runway rails hold the tower stationary in the highest winds. An anemometer measures and records wind velocity and automatically supervises setting of the rail clamps as a safety measure. The operator controls the rail clamps and travel motion, in addition to bucket motion.

Operator's station is a small cab on the water side of the machinery house. The cab is propelled by a rope-driving engine, under the control of the operator, that permits positioning the cab to obtain best visibility when digging coal in the bottom of a ship's hatch. The operator also may raise and lower the apron to permit travel past ship masts. An adjustable chair and an electric heater in the cab help maintain high all-day efficiency in unloading operations.

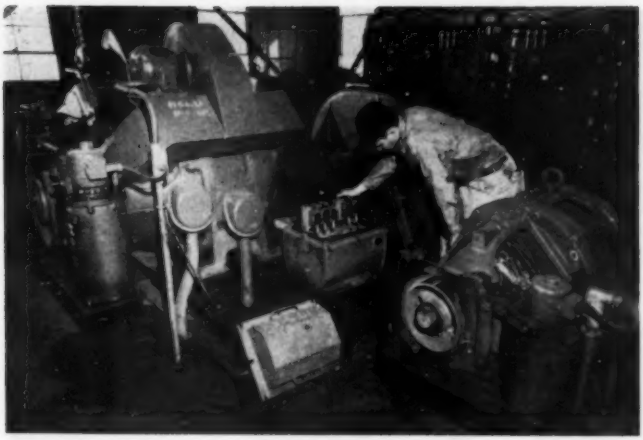
This five-ton, two-rope bucket is supported from a rope-driven trolley that is propelled between the ship hatch and the coal delivery hopper by a motor-driven drum in the machinery house at the rear of the tower. The house also contains the duplicate motor-driven apparatus controlling the opening, closing, hoisting and lowering of the bucket.

All gearing between motors and driven loads on the tower are contained in oil-tight cases requiring practically no maintenance. Safety ladders and stairways provide access to all locations requiring periodic inspection. Adequate lighting is provided for night operation of the unloading tower.

Unloader was designed to operate at a maximum unloading rate of 600 ton per hr, based on a 48-ft lift and a 46-ft trolley distance. Hatch openings, maneuverability and structural considerations indicated the use of a 5-ton bucket, which required hoist and trolley speeds to meet a 30-sec cycle, or 120 trips per hr. The bucket hoist engines are geared for a full-load bucket speed of 384 fpm while the trolley engine is geared to operate at 470 fpm. The tower travels at 50 fpm and the apron is raised or lowered in approximately 5 min.

From a normal seated position the operator can control motion of the bucket hoist engines, trolley drive engine, rail clamp drive and tower moving power equipment. By standing behind his chair he can control the lowering and raising of the apron and change the position of his cab with respect to the boat hatch.

Normal unloading involves the two



Machinery room, in the tower house, contains forced ventilated motors, brakes and limit switch. Control panels are in the background with the resistors mounted overhead. Operation of equipment is manual or automatic from cab

bucket drives, which are under the right hand and the trolley drive, which is under the left hand. The bucket is closed, then hoisted simultaneously with *In* travel of the trolley. Trolley motion is reversed while the bucket is being opened to empty into the hopper. The bucket is then lowered simultaneously with the *Out* travel of the trolley. Frequent reversals and stops, associated with this action, require the dissipation of a considerable amount of energy, nearly all of which occurs in the electrical system—thus avoiding costly maintenance of heat producing brakes and clutches. By simple manipulation of the two master switch handles under his right hand, the operator can lower and stop the bucket when it is open or closed. He also can open or close the empty bucket while it is descending.

Bucket can be placed under hatch combings by releasing the rail clamp with a foot switch and moving the tower with a left hand master switch to produce pendulum action by the bucket, then dropping it at the end of the swing. This degree of maneuverability has resulted in the complete elimination of clean-up shovelers in the unloading operation.

Automatic Control

At the option of the operator, by means of a transfer switch in the cab, automatic control of the trolley and bucket over the hopper may be obtained. Faster unloading during free digging has resulted with less operator fatigue. Automatic dumping control takes over only if the bucket has reached an adequate height before the trolley reaches a preset *In* position traveling at full speed. When these conditions are met, the trolley is reversed automatically and, at the proper degree of swing, the bucket is rapidly opened and stopped in the open position. Control is returned to the operator during the *Out* travel of the trolley. Operators' efforts are confined to lowering and hoisting the bucket and controlling the trolley only at the outer end of the runway.

Extruded aluminum trolley conductors for feeding power to the traveling unloader were used. Aluminum has been employed in this manner for gate operations on dams and in feeding overhead crane runways but has not been widely utilized for tower and bridge runways. It is particularly well suited for a-c systems where close spacing is essential to minimize voltage drop. Current collector designs permit spacing the conductors on considerably less than 12-in. centers on 440-v systems. The contact surface and required cross section area for carrying the total load current are incorporated in one aluminum device, in contrast to steel rail or angles reinforced with copper cable, which have been more common. Corrosion problems are also minimized with the aluminum conductors and self-lubricating collector shoes.

At the point where 440-v, 3-phase, 60-cycle power is received on the tower, the electrical system supplies a 600-amp weather-proof safety switch, which can be pulled in an emergency to stop all motion. It also can be locked in the open position for parking the tower during idle periods, or when electrical work is being performed. From this safety switch the power is carried to the machinery house where a three-pole, air-insulated circuit breaker is provided, with an interrupting capacity of 25,000 amp. This circuit breaker is equipped with a remote tripping device located in the cab, to permit the operator to remove all power from the crane and thus stop all the motions in an emergency.

Electrical energy is then distributed to the several drives. The application of wound-rotor motors on the bucket hold and close drives and the trolley drive is conventional. The use of squirrel cage motors on the apron hoist, tower travel and rail clamps is somewhat unique.

Wound-Rotor Motors

Hold and close drives associated with the two-drum type of bucket operation are equipped with wound-rotor motors and counter-torque full-magnetic reversing alternating-current control. This control system has been widely employed on two-motor a-c buckets and offers the features of simplicity and good bucket performance. In hoisting, the wound-rotor motors operate in a normal manner. The motors lower the bucket at full speed as induction generators operating at slightly above synchronous speed. To retard the bucket, the operator moves his master switch to a slower speed position. The directional contactors are reversed, high secondary resistance is inserted, and the motor is pulled by the overhauling load in the direction counter to the rotating field. The retarding torque is controlled by the amount of secondary resistance inserted.

The close drum is provided with a slightly larger pitch diameter than the hold drum. This serves a twofold purpose: (1) the empty bucket remains open during lowering. Since the hold motor is carrying the full weight of the empty bucket, it runs at above synchronous speed while the close motor runs at slightly below synchronous speed. The difference in drum diameters equalizes the rope speeds and (2) the full bucket remains closed when hoisting. The difference in drum diameters would cause the close motors to run slower than the hold motor in hoisting, and thus take the larger share of the load. Permanent slip resistance allows the close motor to run at the reduced speed and assume its proportionate load.

Manual Operation

The operator, by slightly offsetting the master switch handles, can lower a fully loaded bucket without spilling.

Incorporation of automatic dumping performance involved special limit

Portal view of unloader showing 440-v, 500-amp main power collector system of extruded aluminum along 400 ft runway

Apron hoist and bucket hoist drums are located in the foreground, while electrical controls for all drives are at left

switching to control the hold, close, and trolley motions. In view of the several initial adjustments necessary to incorporate such automatic dumping, these limit switches are of the cam type, featuring a high degree of accuracy and ease of adjustment of the individual switch units.

Apron hoist control drive is provided with a 2-to-1, two-speed, hoist-type squirrel-cage motor. A very heavy load is encountered with the apron in the lower position, and the load becomes increasingly lighter as the apron becomes more nearly vertical. Apron movement at essentially the same speed is desirable over this widely varying load condition. A squirrel-cage motor operates essentially at synchronous speed under either positive or overhauling load conditions and is well suited to such an application. One speed of operation for raising and lowering the apron is adequate, with another reduced speed for operation at the extreme ends of travel when transferring the load from the rope to the links and when placing the apron into and out of the latch.

Starting

Full-magnetic reversing controller starts the motor on full voltage on the low-speed winding and inserts a step of cushioning resistance during transfer between low speed to high speed. The operator has complete control from the two-point reversing master switch with supervisory automatic slowdown at the ends of travel under the control of a traveling nut limit switch geared to the apron hoist mechanism. The drive is supplied with a brake on the drive motor shaft and a band-type holding brake operated in the same manner.

Tower is propelled by four hoist-type, intermittently-rated squirrel-cage gearmotors with an output speed of 62 rpm. These have integrally-mounted disc-type brakes and provide a single point of tower travel with a step of primary cushioning starting resistance. The operator is provided with a two-point master switch in his cab to permit retaining this resistor for slow-speed jogging operation.

Brake Operation

Since there is no direct current available on the pier, the rail clamps are provided with an alternating-current drive. They are raised by a wound-rotor motor. Clamps are held released by an electrically-set shoe brake. When it is desired to lower the clamps, either at the desire of the operator or upon power failure, they are lowered at a reasonable speed under dynamic-braking control. To achieve this, a d-c generator, mounted on the same shaft as the motor, supplies excitation to the terminals of the wound-rotor motor during lowering. Since the clamps, in lowering, provide a constant overhauling load, a single value of motor secondary resistance is all that is required. A 10 per cent permanent slip section of resistance has been placed in the secondary circuit for hoisting, and the motor is started across the line. The result is a simple drive providing adequate control of the rail clamps, with a degree of individual adjustment of both hoisting and lowering operation. The d-c exciter is rated 0.8 kw at 440 v at 660 rpm, which is the anticipated lowering speed of the rail clamp drive.

Selection Procedure

In selecting the electrical equipment, the utmost attention has been given to securing adequate performance with the maximum safety to personnel, and at the same time retaining the greatest simplicity with other objectives.

TABLE I — CONNECTED HORSEPOWER

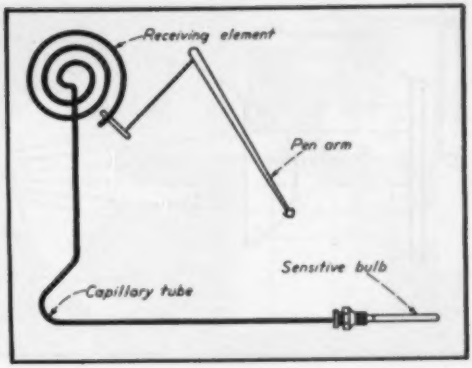
Drive	Hp	Type	Speed	Enclosure
Bucket-hold	150	Wound rotor	690 rpm	Enclosed — forced ventilated
Bucket-close	150	Wound rotor	690 rpm	Enclosed — forced ventilated
Trolley	50	Wound rotor	690 rpm	Open — self-ventilated
Apron hoist	20/10	Squirrel cage	1050/525 rpm	Open — self-ventilated
Tower travel	10	Squirrel cage	1600 rpm*	Enclosed — self-ventilated gearmotors
Rail clamps	7½	Wound rotor	800 rpm	Enclosed — self-ventilated

*Motor speed
Gearmotor output speed = 62 rpm

INSTRUMENTS TO FIT THE JOB

What temperature measurement instrument to select for a specific job entails a knowledge of the characteristics of these devices. Here is information on the most common units employed, their application, advantages and principal differences

WARREN WALKER Jr.,
Industry Engineer, Steel and Ceramics, Minneapolis-Honeywell Regulator Co.



Pressure type thermal system contains a sensitive bulb, capillary tube, spiral element and a recording instrument

MEASUREMENT AND CONTROL of temperature in various industrial processes is a matter of vital importance to all branches of industry. Quality of product and economy of operation are largely dependent on the proper application of temperature measuring and controlling instruments. Since the basis of control is accurate measurement, the principles and equipment used, with the advantage and limitations of each, should be thoroughly understood.

Heat manifests itself by marked changes in the physical state of the body heated. Among these changes are seven, which are utilized as the operating principles of temperature measuring instruments. These are: increase in dimensions; increase in pressure, if confined; thermoelectric effect; change in electrical resistance; increase in radiant energy, change in state (i. e. freezing, melting, etc.) and change in color.

Increase in Dimensions—This principle is utilized both in the familiar mercury in glass thermometer and in the bimetallic type. While extremely accurate, and in some cases functioning as controllers, their industrial application is rather limited.

Increase in Pressure—Heating of a confined vapor, gas or liquid causes an increase in pressure. This is the basic principle of most of the industrial instruments known as "pressure type" thermometers. These instruments are often used in industrial applications.

Thermoelectric Effect—The thermoelectric effect produced by the heating of the junction of wires made of two dissimilar metals (a thermocouple), provides the operating principle of the majority of industrial temperature measuring instruments, especially in the temperature range above 1000 F.

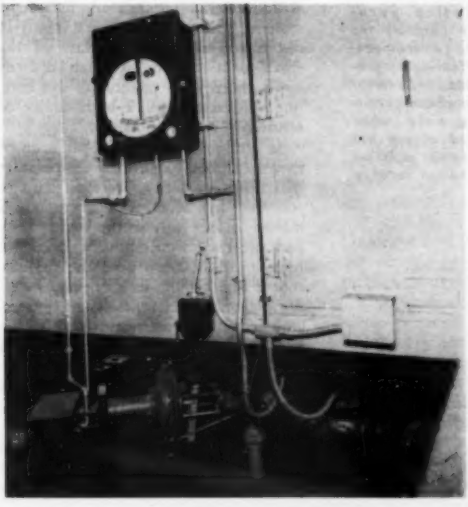
Change in Electrical Resistance—Heating of metallic element, such as a wire coil, produces a change in its electrical resistance. This change can be measured and read in terms of temperature. This principle is commonly employed for narrow spans in the lower temperature range.

Increase in Radiant Energy—The electrical measurement of the increase in radiant energy and the conversion of this measurement to temperature units is the newest principle utilized in industrial temperature measurement.

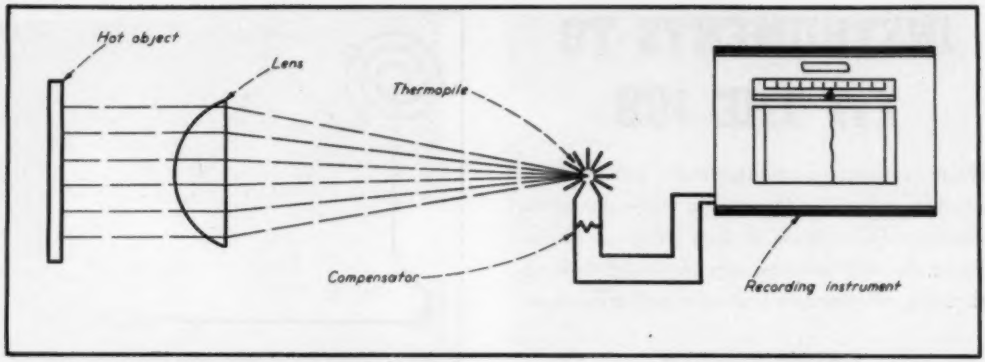
Change in State—This is the most elementary means of noting a change in temperature, a familiar example of which is the melting of ice and freezing of water.

Change in Color—The most primitive temperature measuring means, where the observer judges the furnace or product temperature by the color and appearance, has served its time. The modern counterpart is found in the optical pyrometer of either the disappearing filament or the self-balancing type. The latter is sometimes used for measurement of rapidly moving objects, as in steel forming operations.

Pressure type thermometers are sometimes employed for low temperature applications with 1000 F as the approximate upper limit. This instrument consists of a metal bulb connected by a capillary tubing to a spiral actuating element with the whole assembly filled with fluid under pressure. A change in temperature at the bulb causes a corresponding change in pressure of the actuating medium within the sealed thermal system. This pressure change produces a winding or unwinding effect on the actuating spiral,



This pressure type thermometer controls furnace temperature by actuating an air operated valve to limit or increase the fuel flow



Radiation sensing element for high temperature measurement consists of a thermopile (that includes several thermocouples conected in series), a lens for focusing radiant energy upon the thermopile and a convenient recording device

thereby moving the recording pen or pointer across the chart or scale.

Chief advantage of the pressure type thermometer is the low initial cost. It is limited in use to temperatures below approximately 1000 F. Several disadvantages should be carefully noted, the most important from a production standpoint probably being the ease with which the capillary may be damaged and the difficulty of remedying such damage. It is impossible to repair the thermal system of this type instrument on the job. Instead, the entire thermal system must be removed and returned to the manufacturer. Therefore, unless spare thermal systems are kept on hand, the use of the instrument is lost for a matter of weeks.

Where the instrument must be located at a considerable distance from the point of measurement (as with a central control panel), the long lengths of capillary tubing necessary materially increase the cost of the instrument and decrease the response speed and sensitivity. Longer lengths of capillary also multiply the chances of damage.

Another disadvantage in some cases is that a separate complete thermal system, including the actuating spiral, is required for each temperature measured. The physical size of the instrument case limits the number of spirals and pens that can be used. Most instruments of this type are limited to three actuating spirals.

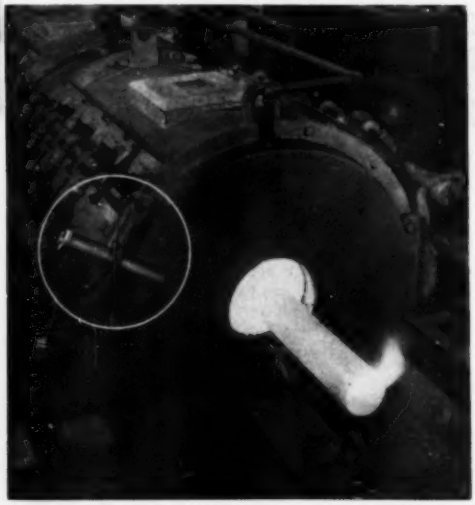
With the exception of the limitations noted above, thermometers are quite adaptable to control applications. Normally, they should be installed for the lower temperature ranges where the instrument can be located close to the point of measurement.

Thermocouples consist of two pieces of dissimilar wire welded together at one end, which when exposed to a temperature change produce a measurable electrical effect. The welded tip is called the *hot junction*. The small voltage generated by a thermocouple depends on the temperature difference between this junction and the unwelded end known as the *cold junction*. By use of suitable extension wire, this cold junction is extended to the measuring instrument.

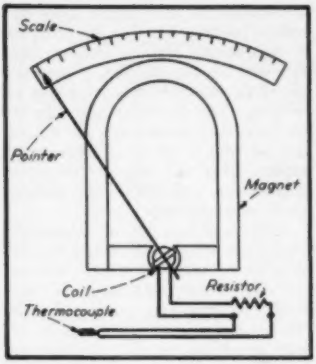
Thermocouples are made in a variety of sizes and from many combinations of metals, which permit measurement of temperatures ranging from well below zero to above 3000 F. Thermocouples can be obtained for almost any application. Least expensive of the primary measuring elements employed with electrical temperature measuring systems, thermocouples are readily tested and repaired. Because of the small mass and the fact that on many applications, it is possible to use bare, unprotected couples, a high degree of sensitivity can be obtained.

In a discussion of the application of thermocouples to process temperature measuring problems, it is difficult to conceive any actual limitations. As a matter of fact only in the higher temperature ranges encountered in certain furnace applications does the thermocouple lose ground as a primary measuring element. Here, the high temperature combined with the corrosive action of the furnace atmosphere can bring about a relatively rapid deterioration of the protecting tube and the thermocouple, requiring periodic replacement of both.

A list of typical thermocouple applications would include practically every process where temperature is an



Radiation pyrometer controls the furnace temperature for metal production. Instrument will perform consistently only when sighted object has a constant emission of radiant energy



Millivoltmeter is known as a deflection type temperature indicating instrument

Applications for the millivoltmeter are numerous, and it is installed frequently. Unit consists of a calibrated galvanometer, compensating resistor and thermocouple

important variable. In almost every case, the decision as to whether or not a thermocouple should be employed will depend largely upon consideration of all the arguments for and against the employment of electrical temperature measurement.

Designed originally for the measurement of extremely high temperatures, radiation sensing elements find many industrial applications. Briefly, this primary device consists of a thermopile (a number of very small thermocouples connected in series) and a lens for focusing radiant energy upon the thermopile.

Operation of a radiation pyrometer is based on the fact that radiant enegry emitted by a hot body varies approximately as the fourth power of its temperature. Since this radiant energy is focused on the thermopile, there will be a corresponding change in the emf transmitted from the primary element to indicating or recording instrument.

With a radiation detecting element, measuring high temperatures in corrosive atmospheres is possible, while the life of a thermocouple would be prohibitively short. Since the element is sighted on the object whose temperature is being measured and is not in physical contact with it, temperatures of moving objects can be measured. This factor also contributes toward long life and low maintenance.

Developments in the field of radiation pyrometry now make possible the utilization of this method of measurement in the relatively low temperature range of 125 to 350 F. Although a radiation pyrometer is a relatively expensive primary measuring element, the basic device was designed for applications where other measuring elements cannot be employed.

Obviously, any concentration of dust or smoke coming between the radiation detector and the object upon which it is sighted, will temporarily upset the instrument reading. The unit will perform consistently only when sighted on an object whose emissivity (ability to emit radiant energy) is constant. The emissivity of some materials such as polished aluminum varies greatly with temperature, a condition that will cause an instrument basing its operation on radiation measurement to give erroneous temperature indications.

As mentioned previously, several types of electrical instruments are available as indicators or recorders and with pneumatic or electric control. All of these instruments can be supplied with resistance thermometer bulbs, thermocouples, or radiation units as the primary measuring element.

Least expensive of the electrical temperature measuring instruments, the millivoltmeter is known as a deflection type instrument. It employs a galvanometer calibrated in accordance with the electrical characteristics of the primary measuring element. This galvanometer consists basically of a small coil suspended in a magnetic field. Voltage generated by the primary measuring device is passed through this coil, setting up a torque that is opposed by delicate hair springs. Since the indicating pointer is fixed to the suspended coil, the instrument is calibrated to provide a coil rotation proportional to the voltage generated by the primary measuring device.

Chief advantage of the millivoltmeter pyrometer is relatively low initial cost when compared with other electrical temperature measuring instruments. Where indication of temperature is desired, it can operate in a location remote from any source of electric power.

Main objections to millivoltmeters are: 1—lack of sensitivity to very small temperature changes over narrow temperature spans, 2—susceptibility to damage from vibration and mechanical shock and 3—effect of circuit resistance upon the operation of the instrument, a factor that limits the allowable distance between the point of measurement and the indicator or recorder.

Potentiometers are known as *null balance* type of instruments as opposed to a millivoltmeter, which is a *deflectional* type. For purposes of comparison, a millivoltmeter can be likened to the familiar penny weighing scale, where the weight of the person on the platform is opposed by an internal spring mechanism. A potentiometer, on the other hand, functions in the manner of a precision balance in which the unknown weight is placed in one pan, and known weights are added to the other pan until the indicating pointer rests on zero.

There are two types of potentiometers in general use today: mechanically balanced and electronically balanced. The basic principle employed is the same in both types: that is, balancing the unknown voltage developed by the primary measuring element against the known voltage from a battery within the instrument. A change in temperature at the measuring element causes a condition of unbalance in the electrical bridge circuit. Amount and direction of unbalance are measured and the slidewire is repositioned to effect balance. Repositioning of slidewire or contact moves pointer or pen to indicate or record the temperature.

In the mechanically balanced instrument, direction and amount of unbalance are indicated by a galvanometer. A detecting mechanism determines the position of the galvanometer pointer and, through a mechanical linkage, repositions the contactor on the slidewire until re-balance is obtained. De-

tecting and balancing actions are periodic, resulting in an inherent lag. The large number of moving parts employed results in appreciable wear and increased maintenance. Where the instrument is located a distance from the primary measuring element, the external resistance of the long extension wire may decrease the sensitivity.

Most modern instrument in the field of temperature measurement is the electronic potentiometer. It combines the advantages of the mechanical potentiometer with additional advantages. Like the mechanical instrument, the electronic potentiometer utilizes the potentiometer bridge circuit.

In the latter instrument, however, a compact electronic unit performs *continuously* the same task that the multiplicity of moving parts in the mechanically balanced potentiometer perform *periodically*. The galvanometer and mechanical detecting mechanism of the mechanically balanced type are replaced by a small unit. This device amplifies the unbalanced voltage electronically and uses the amplified unbalance to control the speed and direction of rotation of a balancing motor, which in turn drives the pen and pointer. With the electronic instrument, temperature measurement is continuous rather than periodic, i. e., a change in temperature sensed by the primary measuring element causes immediate repositioning of the pen and pointer. Speed of response of such an instrument is limited only by the speed of response of the primary element.

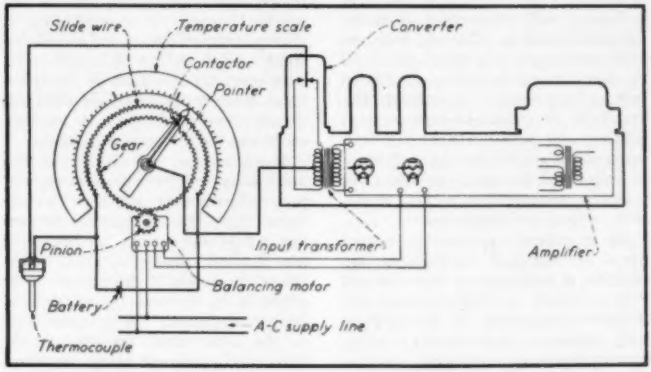
Neither the sensitivity nor the accuracy of this instrument is affected by external circuit resistance, a factor that makes possible locating the indicator or recorder any practical distance from the point of measurement. It is ideally suited for multiple indicating and recording. The electronic unit, like the mechanical potentiometer, is suitable for use with a variety of primary elements. This, of course, simplifies maintenance and reduces the stock of spare parts normally carried.

There is no one type of temperature measuring system, which can be said to be most economical or most practical for all processes. Although an electronic potentiometer can handle any process temperature satisfactorily, its high speed and extreme accuracy may be nullified by initial cost on some applications. Conversely, although pressure type thermometers, because of relatively low initial cost, might seem the answer to most temperature measurement problems, the point may be reached where a combination of the characteristics inherent in each type of instrument will result in the long term cost (in some cases, even the initial cost) of a pressure-type thermometer equalling an electronic potentiometer.

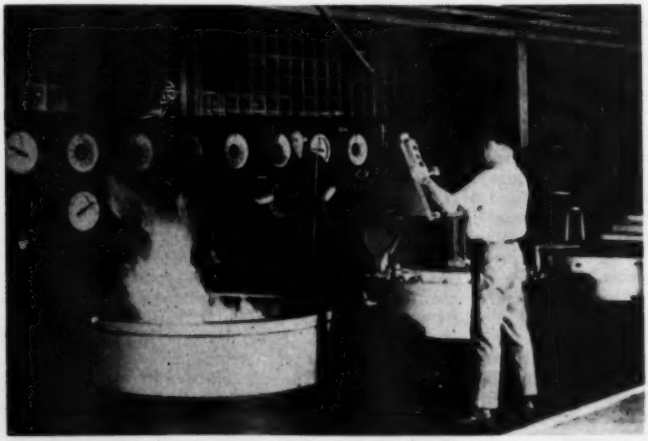
Each problem of temperature measurement or control should be considered separately and analyzed to determine the exact instrument requirements. Factors to be considered are:

1. What degree of sensitivity and accuracy is called for?
2. What is the range of temperature involved?
3. Will the instrument be close to or remote from the point of measurement?
4. Should the instrument be an indicator, a recorder, or an indicating and/or recording controller?
5. Would it be advantageous to have records of several closely related temperatures on a single chart?
6. Type of control needed—pneumatic or electric—on-off or proportioning?
7. If the instrument is to be a controller, is the process batch or continuous, i.e., is continuous trouble-free operation of the control instrument a "must"?
8. Is use of a centralized control cubicle contemplated?

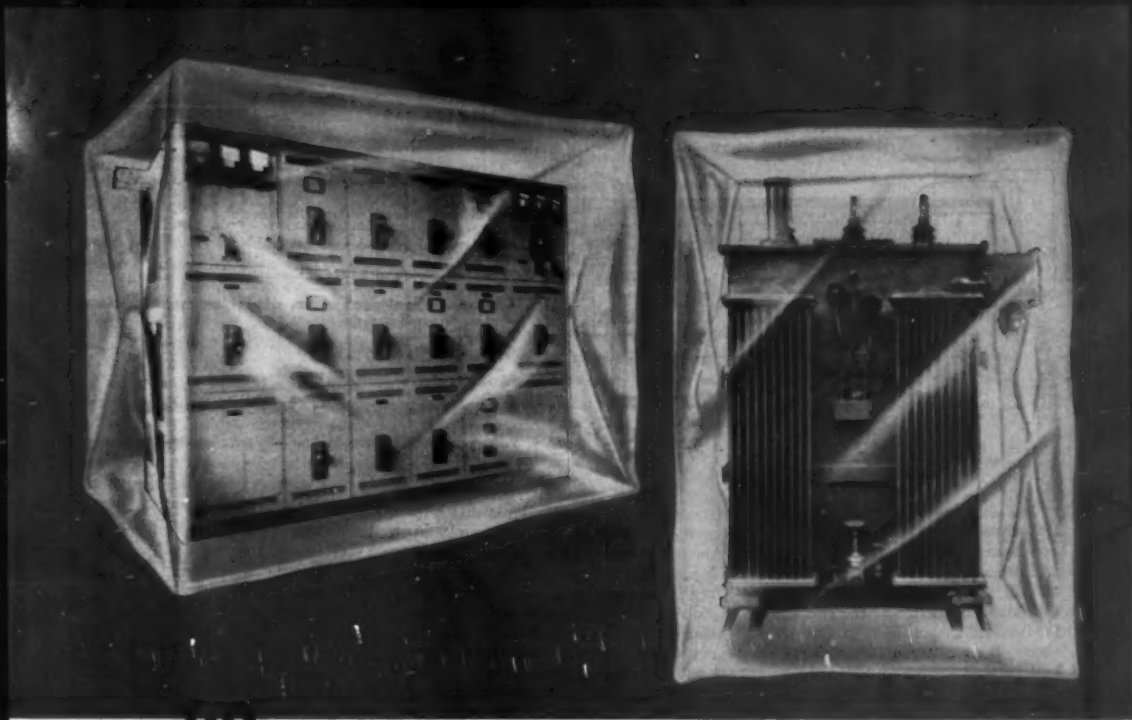
Experience proves that in the majority of cases the most satisfactory temperature measuring systems result from the joint planning of operators and experienced instrument engineers. Since all instrument manufacturers maintain staffs of engineers who are thoroughly familiar with the capabilities and limitations of the various types of temperature measuring instruments, operators should, wherever possible, enlist their cooperation.



Schematic wiring diagram of an electronic potentiometer illustrates the component parts. Unit combines the advantages of mechanical potentiometer and electronics



Electronic potentiometers are adapted for controlling process temperatures. The unit is suitable for a variety of primary elements and simplifies maintenance



SPECIAL REPORT TO INDUSTRY

PACKAGED ELECTRICAL DISTRIBUTION EQUIPMENT

A. B. WHITE, ***Associate Editor***

● Each month INDUSTRY AND POWER will publish selected articles presenting the best engineering information and thinking on various phases of engineered electrical plant services. Many of the articles will refer directly or indirectly to the distribution system. In order to establish a background of modern practices for them, this report surveys recent equipment design and the preferred types of system layout.

The style of presentation is such as to take the reader through the preliminary layout and selection of new, expanded or rejuvenated distribution systems for both the primary feeder and load center circuits. Included in the report are problems encountered, methods of solution, engineering practices, and a discussion of the features, advantages and applications of modern, packaged distribution equipment.

For information on reprints, see page 98.

Features

Factory prefabricated and wired units are assembled from standard components and designs to fit individual needs. Many sizes and types fill most requirements.

Highly sectionalized, the smaller sections are combined to form complete units in line with modern concepts of unit load areas. New blocks of power can be added as needed.

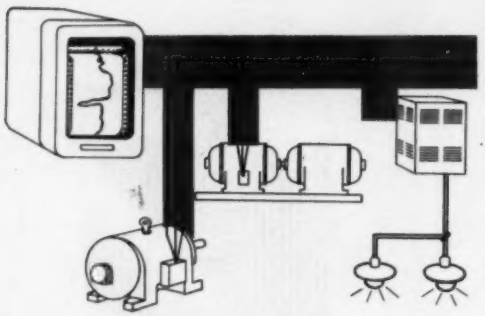
Self contained, each unit is shipped and installed complete, requiring only connection of input and output lines and remote control leads. Usually packaged units can be installed before alterations and new construction are complete.

Metal-enclosed and metal-clad, the enclosure is the mounting for components, structural base for the complete unit and protection from dirt. Designs for outdoor, corrosive or hazardous conditions are available.

Safe for personnel, it can be located in working areas without special enclosures.

Selecting the system and equipment →

Know your load



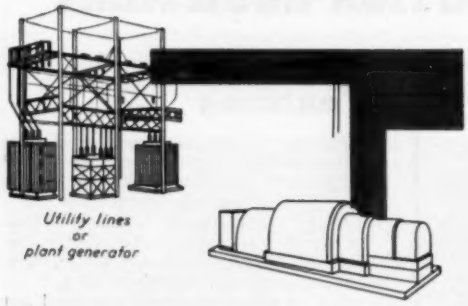
1. **Total** plant power load handled by the distribution system.
2. **Power** used in each discrete load center.
3. **Area** covered by each load center.
4. **Expected** growth of power utilization.
5. **Size, number, voltage** and duty cycle of large motors, resistance welders, furnaces and the like.
6. **Ratio** of power to lighting loads.
7. **Power factor** of load.
8. **Degree** of reliability required for various plant processes.
9. **Voltage regulation** required for efficient operation of equipment.

The distribution system is the vital link between the source of electrical power and the motors, lights, controls and other utilization equipment necessary in the operation of the plant. A thorough knowledge of the end use of the power, as outlined in the table above, is necessary in determining the best economic compromise between cost of the system and quality of service provided.

Increased power usage is almost inevitable for an industrial plant. Mechanization of processes is reflected in the constantly rising value for the kilowatts per man-hour figure and immediately leads to a prediction of overloaded distribution facilities now existing if the plant is to meet competition. Add to this the present industrial expansion in which most plants plan to participate, and the immediate possibility of being called upon to take part in military production. The result is the almost universal recommendation that *any major change* in the distribution system be considered as part of a modern load center system.

Fortunately the load center system, introduced to industrial plants about 15 yr ago because of its engineering and economic advantages, also allows individual load areas to be handled as discrete units and to be treated as separate small plants, each with its own feeder (secondary) system. The natural evolution of the "building block" concept permits the engineer to analyze his system in the same manner, and to renew, modernize or expand each section, or all sections, as the occasion demands.

Know your supply



1. **Capacity** to handle new and anticipated future loads.
2. **Voltage** available to primary substation of distribution system.
3. **Reliability** of source as affected by storms and other outages.
4. **Variations** in voltage which may affect plant operations.
5. **Regulation** of the supply, which may affect voltage stability and short-circuit fault currents.
6. **Penalties** imposed for peak demand and low power factor.

Capacity of the utilities is ordinarily taken for granted because of their phenomenal expansion. However, power consumption is keeping pace, and while all signs indicate that overall supply will eventually be adequate, overloaded areas and temporary shortages may appear at a given plant site. Even the consumer who generates his own power is not exempt because there is nearly always an interconnection with the utility lines for the purpose of obtaining emergency and peak load power and/or disposing of excess power when plant load is low.

In any case, voltage variation and regulation of the supply may affect choice of components for the distribution system. A system engineered to obtain the ultimate in good regulation and reliability is economically unsound and wasteful if the source of power is inadequate or cannot be compensated for as with voltage regulators.

Frequently some phase of the load picture as determined above may, in combination with the characteristics of the supply, affect choice of system and equipment. Large motors or welders often create voltage dips which, if tolerated at all on the utility lines, must be eliminated from other sections of the plant system. Penalties for peak demands and low power factor may make it advisable to consider provision for m-g sets or capacitors.

Codes allow voltages below 15 kv in plant distribution systems and power at this level or below may, with suitable switchgear, be used to supply load center substations.

An analysis of the load and a discussion with the utility representatives are the usual preliminaries to any appreciable change in the plant system.

Load area size

Success of the load center system is based on sectionalizing the plant area and extending the benefits of high voltage transmission by making final transformation to working voltage at the site of each utilization area. Obviously, size of each section becomes an immediate question, since below an optimum area, cost of equipment, which is the final basis for selection, begins to rise.

Final selection of load area and secondary substation size may be modified by many factors, the most common of which are listed in Table 3. However, in the preliminary survey of plant needs and layout, it is well to have the basic concept of optimum size based on past experience from other installations and on the economic analyses of the manufacturers on hand to aid in division of the plant into discrete load areas.

Curves in Fig. 1 are based on average conditions and show variations in optimum size as influenced by utilization voltage. In the case of new systems, the selection, which is weighted heavily in favor of the higher voltages, will help determine voltage rating of utilization equipment. The relatively small increase in cost with size of substation at 440 v also indicates greater flexibility for expansion beyond the optimum size.

Often the lower utilization voltages must be considered for existing plant areas because of a heavy investment in low voltage power and lighting equipment. Best substation size is only about half that for the higher voltages but consideration of new distribution equipment may include possibility of increasing feeder circuit voltages in the future.

That load density does not greatly affect substation size is illustrated in Fig. 2. More heavily loaded feeders (dotted line) favor increased capacity but may not be desirable because of area affected by a fault.

A tentative concept of plant utilization areas provides a basis for a more detailed analysis.

Plant layout—variations in load concentration.

Load density—power demand per square foot.

Concentrated loads—advisability of separating them from general loads.

Primary feeder voltages—may be a compromise between feeder length and number of high voltage motors, etc.

Secondary feeder voltages—may be a compromise between feeder length and existing power and light equipment.

Short-circuit protection—extent of subdivision to increase short-circuit impedances.

Reliability—extent of subdivision to restrict outage area or provide alternate circuits.

Operations layout—Separate supplies for parallel operations (assembly lines, etc.)

Expansion—smaller original sections because of anticipated load increases.

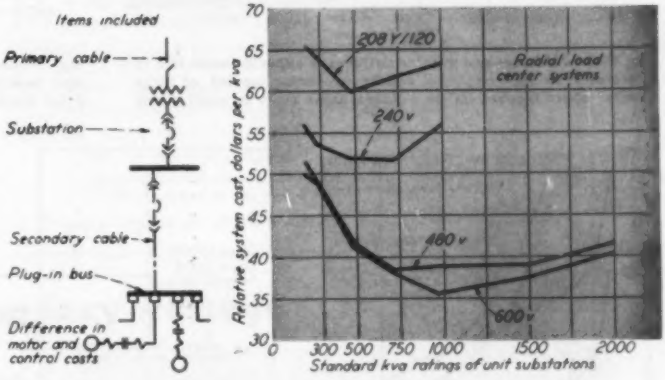


Fig. 1 (above)—Various components shown in the line diagram are included in the data for optimum size of basic radial load center systems. The values in the curves are for average plants, may be modified by the plant conditions

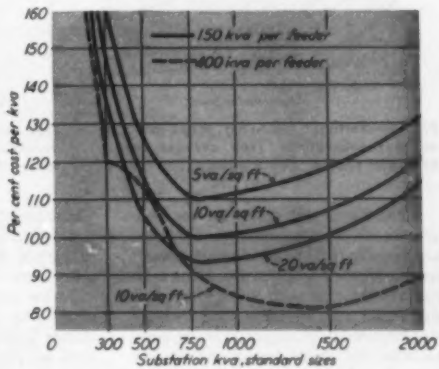


Fig. 2 (right)—A low-load density adds to substation cost but it does not ordinarily change the optimum size. More load on fewer feeders lowers cost but may be undesirable for service continuity

TABLE 4—ESTIMATED LOAD DENSITIES

Type of plant	Light and power, demand, va/sq ft
Small device manufacturing	3½
Lamp manufacturing	5
Small appliance manufacturing, machine repair shop	7½
Chemicals, electronic equipment, general manufacturing	10
Cigarette manufacturing	11
Textile mills, engine builders	12
Paper mills	14
Beet sugar refinery	19

TABLE 5—ESTIMATED RATIO OF LIGHT TO POWER

Industry	Per cent of total load
Steel foundries	1 - 3
Rolling mills, oil refineries	3 - 5
Heavy electrical equipment	5 - 8
Wire drawing mills	5 - 8
Auto equipment, baking	8 - 10
Machine parts	10 - 15
Auto assembly and parts	15 - 25

Choice of primary voltage

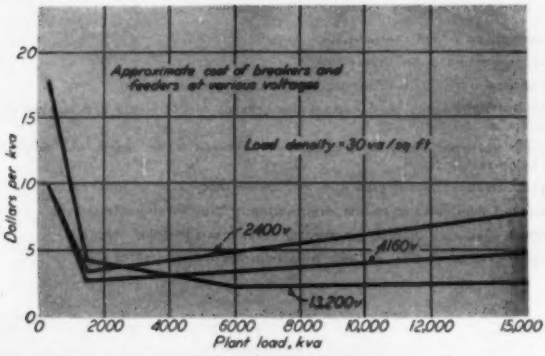

Approximate cost of breakers and feeders at various voltages
Load density = 30 va / sq ft
2400 v
4160 v
13,200 v
Dollars per kva
Plant load, kva

Fig. 3—Lower losses and greater switchgear capacity make 13.2 kv preferable on the long runs and heavy feeder loading of large plants. Short feeders fail to balance other costs in small plants

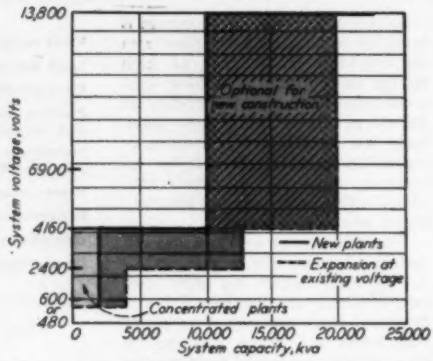


Fig. 4—Experience indicates 4160 v to be best for most smaller plants, 13.8 kv for very large ones, with either level being satisfactory between 10 and 20 mva

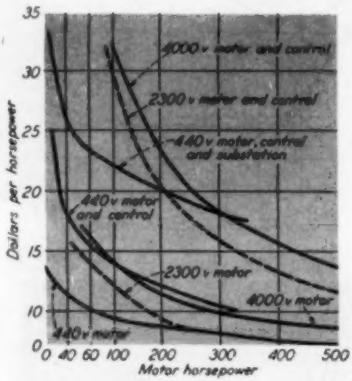


Fig. 5—Voltages allowing large motors without substations (top curves) favor 2400 and 4160 v. Other costs favor 4160 v

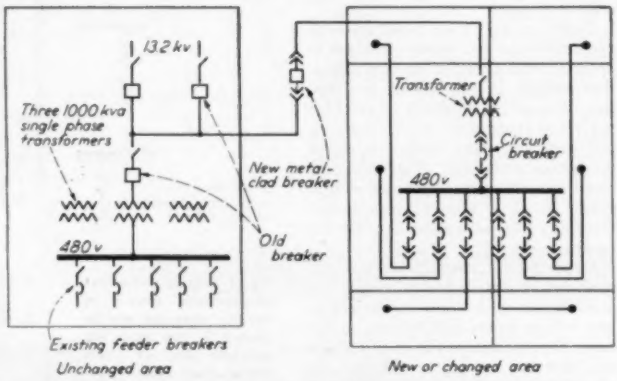


Fig. 6—The load center system permits different distribution voltages in different sections. Advantages of the two levels must be balanced against lower feeder loading, lack of interconnection, extra transformation, etc

Generalized statements on the economics of distribution systems based on average plant conditions always tend to favor higher primary voltages. Savings increase with voltage as plant dispersion and total kva load increase and become quite appreciable for large installations where feeder and breaker costs, Fig. 3, are a predominate factor.

Interrupting capacity on the primary substation bus is one of the most important factors of the system. Larger systems need the greater capacity available at higher distribution voltages to prevent a bottleneck in present or anticipated capacity. Switchgear costs are lower for large loads.

For plants of moderate size, however, low capacity switchgear costs begin to favor lower voltages. Longer primary feeder runs are needed to offset high voltage switchgear expense. Consequently, for plants in confined quarters as in metropolitan areas, feeder length should be balanced against other costs.

In the extreme, concentrated plants up to 3000 kva capacity, and with secondary feeder runs less than 300 ft may need no primary system, utility power being transformed directly to the utilization voltage. However, it is usually recommended that the load be sectionalized to between 300 and 1000 kva units to provide adequate short circuit interrupting capacity and protection against power outage for the entire plant in case of fault in one section.

Plant Generated Power

Capacity of plants generating all or part of their power is usually great enough that the highest voltages allowed by the codes are advisable. Furthermore, generating equipment and switchgear favor high voltages with respect to cost and stability. In existing installations, voltages are often low and cost of new control equipment and primary substations become important considerations that may increase the total load, Fig. 4, at which it is advisable to change to a higher primary system voltage. Nevertheless, plants with loads of 10,000 kva up and spread over a wide area may find it preferable to change to the higher value, especially when expansion is contemplated. Generators are then rewound or their output transformed to primary system voltages.

Utility voltages of 15 kv or below may, like locally generated power, determine the primary system level.

When the utility supply is above 15 kv, transformation to a lower voltage

for internal distribution is economically and technically preferable in all plants except a few very large steel mills, chemical plants and the like. In the majority of cases, as illustrated in Fig. 4, either 4160 v for plants below about 10,000 kva total load or 13.2 kv for those above 20,000, and either value for those between is satisfactory. Existing distribution systems will of course extend the plant load at which it is advisable to use a higher voltage.

Dual Voltages

One of the principal advantages of the load center system and packaged distribution equipment is that it is economically feasible and desirable to break the plant load into sections that can be treated as discrete units. The primary system can also be divided and operated at two distinct voltages for (a) step-by-step modernization of an existing system, (b) expansion at higher voltages with or without change in the present system, (c) handling special utilization equipment such as large blocks of 2300 v motors, or (d) special purposes such as supplying a pump house some distance from the plant.

However, dual voltages should be carefully considered as more than one level may require extra transformation, making them unprofitable. Also, in plants up to say 5000 kva, another advantage, that of being able to interconnect load centers for emergencies, may be nullified by their use.

TABLE 6—FACTORS MODIFYING CHOICE OF PRIMARY VOLTAGE

1. Concentrated plants—utility voltage may be transformed directly to utilization voltage when:
   a. Secondary feeders are limited to about 300 ft at 480 v.
   b. Plant load does not exceed about 3000 kva.
   c. If necessary, load is divided between 1000 kva (or smaller) substations to limit fault currents or restrict outage areas.
2. Utility voltages of 15 kv or less can be used in the primary system without transformation.
3. High utilization voltage for large blocks of power. 2400 v motors and control costs less above 200 hp, but large numbers are needed to offset feeder costs.
   a. 150 mva maximum interrupting capacity for switchgear.
   b. Economical feeder loading about 1500 kva.
4. Primary voltages of 4160 v (and 4800 v) allow more for expansion. Motors and control cost less above about 250 hp.
   a. 250 mva maximum interrupting capacity for switchgear.
   b. Economical feeder loading from 2000 to 3000 kva.
5. Primary voltages of 13.2 kv preferred for large plants with primary substations.
   a. 500 mva interrupting capacity for switchgear (higher in multiple enclosures).
   b. Economical feeder loading 4000 to 5000 kva (requires individual protection for load centers smaller than 750 kva).
6. Plant area—advantages of higher voltages increase with load dispersion.

Selection of secondary voltage

Advantages of higher voltages for distribution are even more apparent for the secondary, or utilization, feeders than for the primary. And since a large percentage of system cost is represented in the load center substations and secondary feeders, the choice may be more important. Figs. 1 and 7 show comparative costs. Motor and control prices also favor high voltages to about the same degree.

Theory indicates that the utilization voltage should be as high as possible up to the limits of the 600 v class of equipment. In practice, however, 480 v is almost universally chosen for new load areas because of lack of availability of standard 550 and 575 v utilization equipment. When installing a new distribution system, some existing equipment may require 240 v or 120 v, but consideration of reconnection, or temporary use of small step-down transformers, is advisable in view of appreciable cost savings and lower RI drop for replacement and expansion with 440 v equipment.

Combined Light and Power

Supplying light and power from the same substation is accepted as the most economical method. A 120 v lighting system supplied by small step-down transformers throughout the building may save $6 to $10 per kva total compared to the use of separate substations for light and power. In case of substation outage, light is often insured by overlapping circuits from adjacent load areas. Lighting circuits are more thoroughly treated in the section on secondary load circuits, page 84.

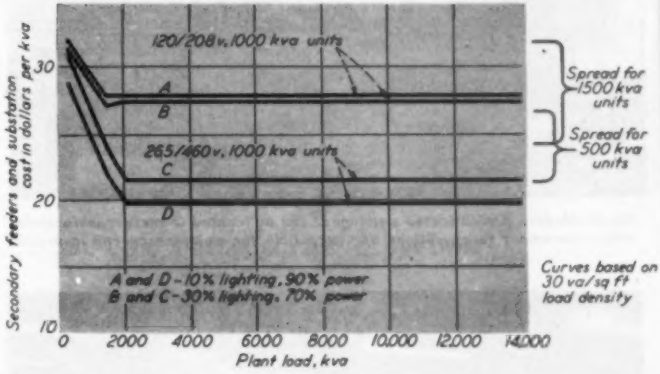


Fig. 7—Lower cost of high voltage substations, feeders, as well as utilization equipment and controls, with the lower line drops, encourage selection of the 440 v level even in present 240 v areas. Availability of 600 v apparatus is poor

Fig. 7 shows that, although the higher percentage of lighting kva gives a greater cost differential on the higher voltages, it is low compared to the overall saving over the 208 v (or 240 v) system. Costs for both voltages increase for substation ratings above 1000 kva, but remain about the same for ratings as low as 500 kva.

The National Electric Code requires that some circuits for lighting and portable appliances be limited to 150 v to ground, requiring step-down transformers where 265 v general lighting is employed in the plant.

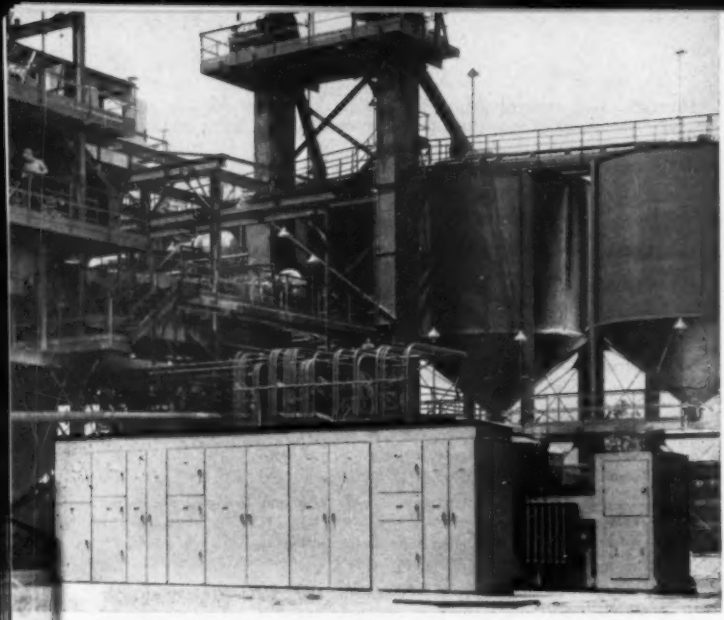


Fig. 8—The chemical industry has pioneered in outdoor plants, and thereby has helped extend the range of locations in which packaged switchgear may be used

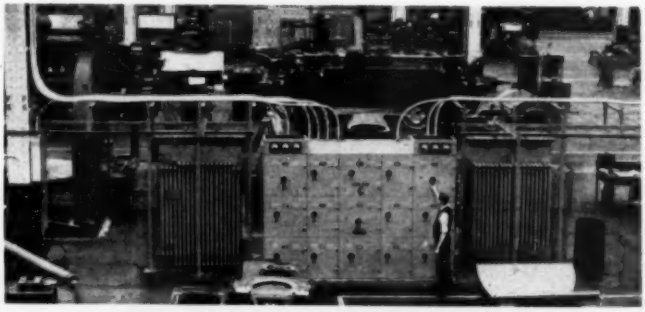


Fig. 9—Modern prefabricated switchgear can be located in most manufacturing areas convenient to operations and accessible for maintenance and inspection

Fig. 10—Safety and appearance make switchgear compatible with most environments. This motor control panel extends the secondary system to a working area

Location

In the majority of cases, packaged switchgear can be placed in the most convenient and efficient location, even though it be in the midst of a working area. However, there are special conditions which should be kept in mind in laying out the distribution system.

Transformers filled with non-inflammable liquids are suitable in most locations. Dry type units are lighter and more flexible, are often preferred indoors, but are not desirable in dusty, corrosive, moist or hazardous locations. The sealed, nitrogen filled, dry type is light and can be used in any atmosphere. Oil filled transformers must be installed in a vault indoors, or outdoors with suitable protection.

Adequate air circulation must always be considered.

Under average conditions, the only advantage of locating switchgear and transformers outdoors is the savings in building space. Units with outdoor enclosures cost 10 to 30 per cent more than those of standard design, and this increase plus the extra length of feeders will be balanced against the cost ($0.50 to $1.00 cu ft) of building space needed for the unit.

However, because of crowded conditions, or other circumstances noted below, substations are often placed outdoors. The plant roof is a popular location since it often allows the units to be near the center of the area served.

Floor space may be saved indoors by placing substations on a balcony, a convenient location that often saves both building and special enclosure costs. Balconies for new substations are often built over old switchgear.

Dust sealed enclosures approach weatherproof enclosures in cost. Outdoor locations may therefore be preferable to dusty areas unless convenience is a big factor. Moist or corrosive conditions may have similar influence.

Cost of equipment for hazardous areas is increased two to four times over that of standard equipment. In order to avoid the excessive expense of explosion-proof designs and still keep cable runs short, substations with outdoor enclosures, and containing all possible control and contact making units, are often installed on the roof over the area.

Equipment with outdoor enclosures and located adjacent to a hazardous area costs 25 to 50 per cent less installed than equivalent explosion-proof equipment located within the area. Furthermore, it can be maintained at any time, and accessibility of switches during a fire or other emergency reduces loss risk considerably. Another advantage is standardization of parts.

Choice of primary circuits

Preceding analyses have been based on average conditions and fundamentals. Normally, the choice of circuits to increase service continuity will not seriously affect the balance upon which the analyses were based, although total cost may be increased by a substantial fraction. Only in those cases where the dispersion of plant centers of activity and choice of circuit greatly upsets the average relation between feeder length, amount of switchgear, and transformer capacity will reconsideration of load center size and primary voltage be necessary.

Inherent advantages of the load center system are savings in copper and switchgear, low losses, good regulation, reliability, and conveniently small unit load areas for installation, operation and expansion. Packaged equipment adds the advantages of ability to go anywhere and to be easily expanded.

Usual considerations in selecting the most desirable system are given in Table 7. No order of preference is given because each engineer must analyze his own plant operations and determine the relative importance of each factor before making his choice of circuit or consulting with manufacturers' representatives.

Source Reliability

Investment in system reliability is wasted if source reliability is poor. With the assessment of the service continuity factor on hand, the next logical step is consideration of the source. Assuming that the power supply in the plant neighborhood is great enough to provide all needs, source reliability will usually depend on the extent of the feeder network that the utility does or will provide, or the ability of plant owned generating capacity to carry emergency loads

The main, or primary substation is the focal point of the distribution system and the all important link with the power source. It is, actually, a load center unit for the utility system, although it may be either utility or plant owned. Basic circuits designed to improve reliability with multiple feeders and transformers are similar to those used in individual plant substations treated in succeeding pages. For simplicity, the primary feeder bus will be considered the principal source for the feeder circuits discussed here.

Circuit Possibilities

Basically, the simplest and cheapest high voltage distribution system is a main feeder circuit radiating to the various substations from which, in turn, low voltage circuits branch to the various utilization devices. Overload and short circuit protection keep outages localized to the area covered by the branch circuits protected, but a fault on the primary system means power interruption for the whole plant.

Alternate circuits for the primary system (and the source) are therefore often desirable. They take the form of either parallel or loop connected feeder circuits, with provisions at both main and load center substations for switching from the faulted feeder to a stand-by circuit.

Load center transformers and/or secondary buses are often divided into smaller units, or duplicated, to provide alternate capacity in case of fault.

Secondary buses of several substations may be joined by low voltage feeders and tie breakers to form a loop. Or since long feeders are costly, interconnection may be limited to paralleling adjacent load areas.

Capacity of duplicated circuits in feeders, transformers and switchgear may be designed to carry their normal and emergency loads only long enough to allow for manual switching, or each circuit may have full capacity to allow for permanent repairs or servicing.

Continuous parallel (or loop) operation of circuits also parallels impedances and reduces voltage drop. Although it is sometimes desirable where heavy intermittent loads are present, it permits higher fault currents and requires greater interrupting capacity and breaker costs.

Normally, complete feeder circuits are shown but many variations are possible for individual load requisites.

The number of substations per primary system depends on feeder loading and plant size. Large plants may have several separate primary systems.

TABLE 7—FACTORS IN CIRCUIT CHOICE

- Relative source reliability.
- First cost.
- Reliability vs production loss.
- Plant area.
- Combined light and power.
- Voltage regulation.
- Operation and maintenance.
- Flexibility in change or expansion.

Low voltage radial system

This circuit is of interest not only for small plants but also because it typifies the extension of the load center concept to smaller sections in the area served by each unit substation of a larger system, the sub-centers being small-motor starter panels, lighting panels, and the like.

Advantages:

- It is simple and easily operated in limited areas.
- Rates high from a maintenance standpoint.
- Cost is low if feeder lengths are short (300 ft maximum).
- Low voltage is necessary for most utilization equipment.

Disadvantages for large areas:

- Feeders must be heavy copper and are costly.
- Voltage regulation is poor.
- Transformer or substation bus fault affects whole area.
- Feeder faults affect area served.

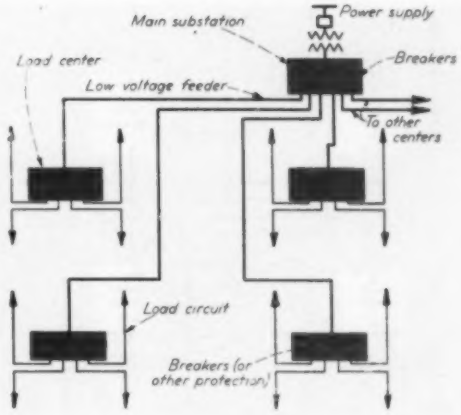
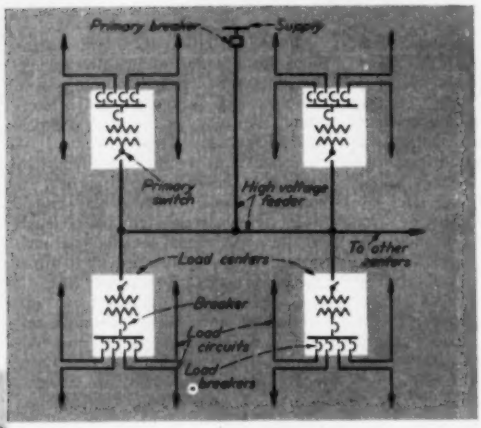


Fig. 11—The simple radial system, common until 10 yr ago, is still recommended for plants of 1000 kva load. Concentrated plants up to 3000 kva may use two or more similar systems, thereby limiting short circuit currents on faults

Modern simple radial



Here is the basic form of high voltage distribution systems. Many plants depend on reliability of equipment to keep outages within reason. Where continuity is more important, alternate or emergency circuits are provided at increased cost. Also used with secondary ties, Figs. 15 and 17.

Advantages:

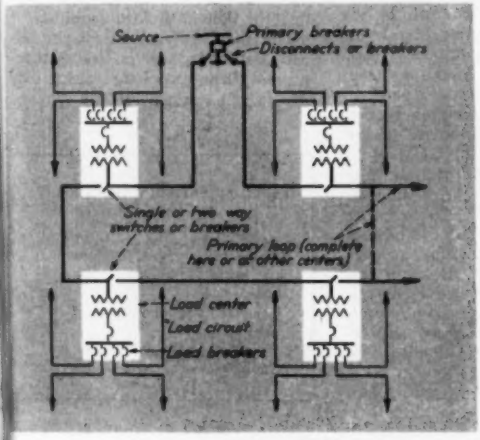
All the characteristics of high voltage distribution.
Low cost, with reliability adequate for many plants.
Fair regulation and efficiency.
Simplicity and ease of operation and maintenance.

Disadvantages:

Fault in feeder circuit gives total plant outage except:
In more expensive (about 20 per cent) modified form (see caption) feeder fault causes outage in section it serves.
High load diversity requires extra transformer capacity.
Flexibility for plant changes is relatively poor.

Fig. 12—This system is the cheapest and most popular since it uses a minimum of cable and equipment. Modified version has separate feeder to each center (with breaker at feeder bus instead of transformer) to localize feeder fault effects

Looped primary radial



Making a loop of the primary feeder circuit increases simple radial system costs only about 5 per cent in average plants but provides an alternate circuit for all other substations in case of fault on one feeder section or transformer. Extra service continuity protection may be worked out with secondary tie feeders.

Advantages:

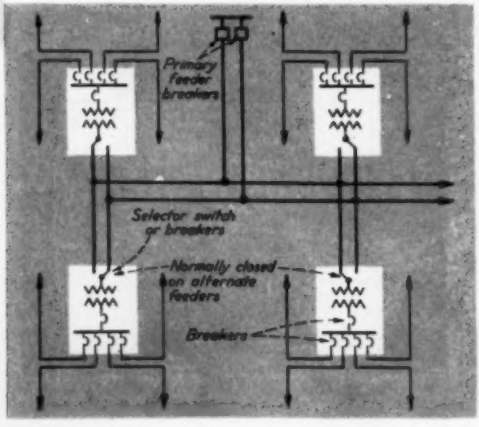
All advantages of the modern simple radial system.
Better flexibility for plant changes.
Better service continuity.
Fair regulation, good efficiency.

Disadvantages:

Part or all of plant load is dropped during fault. Manually operated load break switches in feeder circuit must be reclosed before service can be restored to all but faulted section.

Fig. 13—Depending on layout, the primary loop is usually cheapest method of limiting sustained outage to one load center. Variations include one switch at feeder bus or two each side of transformers. Secondary ties, Figs. 15 and 17

Selective primary radial



Extra feeders increase system costs here by 10 to 20 per cent. Switching is usually manual, causing a short power interruption for the part of plant affected. No protection for transformer faults is provided without secondary ties.

Advantages:

Feeder faults temporarily drop only half of the load.
Separated feeder runs are possible in areas where they are subject to damage.
Normal feeder load is low, improving regulation.
Good from operation and maintenance standpoint.

Disadvantages:

Depending on plant layout, increase in protection is not justified by increase in cost over looped primary.
No service protection for transformer and secondary bus faults.

Fig. 14—Duplication of the primary feeder system is another method of protection against feeder faults. Ordinarily, it is little better than the looped primary. Note that only part of the load centers are normally connected to each feeder

Multiple primary, selective secondary

Emergency power is carried by heavy secondary ties to nearby substation. Transformer, bus and feeder capacity may be chosen to carry minimum emergency loads or full capacity for both areas as needed. Depending on reserve capacity, cost increases are 5 to 50 per cent over simple modern radial system.

Advantages:

- One of the cheapest forms to protect against transformer outage as well as feeder faults.
- No load dropped on transformer or feeder fault.
- Interlocked breakers hold interrupting capacity down.
- Extra transformer capacity improves regulation.

Disadvantages:

- Loads must be balanced on adjacent substations.
- Operation and maintenance factors are only fair.
- Investment may be high for extra transformer capacity.

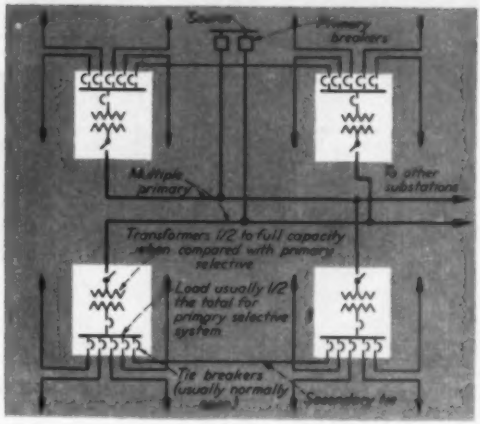

Source
Primary breakers
Multiple primary
To other substations
Transformers 1/2 to full capacity when compared with primary selective
Load usually 1/2 the total for primary selective system
Tie breakers (usually normally open)
Secondary tie

Fig. 15—Known as the single transformer type, it is most efficient where two substations serve a large low density load area, reducing secondary feeder length. Note that the multiple primary might be made selective type at low cost

Primary spot network

Transformers may be switched from a faulted feeder to the good one without dropping secondary load. One unit carries full load until switching is complete. With each transformer rated for normal load, cost is about 40 per cent more than modern radial system. Value of extra capacity is questionable because of modern transformer reliability.

Advantages:

- Excellent service continuity, no load interruption.
- Low cost in view of reliability.
- Good regulation, fair efficiency.

Disadvantages:

- Without extra transformer capacity, continuous loads must be reduced on bus served by a faulted transformer.
- With extra capacity, primary interrupting ratings must be increased, or it may limit size of system.

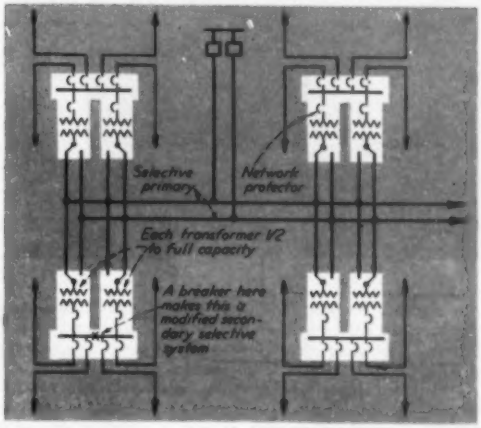

Selective primary
Network protector
Each transformer 1/2 to full capacity
A breaker here makes this a modified secondary selective system

Fig. 16—A primary selective circuit with divided transformer capacity paralleled on the secondary bus, each transformer may vary from half to full capacity. Sometimes used with three transformers per center or with secondary ties

Primary selective, secondary network

Also used with multiple (or simple network) and looped primaries, the secondary loop carries load when a feeder or transformer is faulted until the fault is isolated. Cost increase is up to 60 per cent for excellent emergency protection.

Advantages:

- No load dropped, excellent reliability.
- Flexibility is fair for plant changes or expansion.
- Regulation is good.
- Handles load diversity well.
- Cost is reduced if secondary ties feed part of load.

Disadvantages:

- Some installations may require extra transformer capacity.
- Initial and operating costs are high unless reliability is very important.
- Interrupting duty is high.

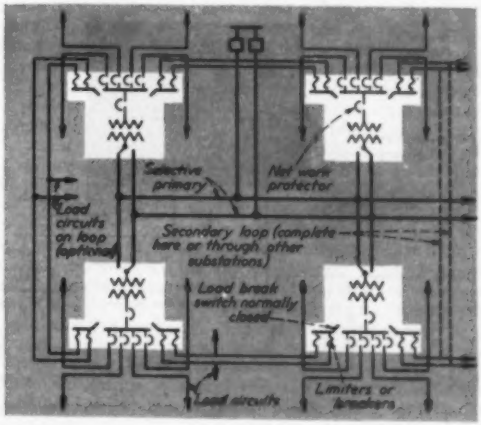

Selective primary
Net work protector
Load circuits on loop (optional)
Secondary loop (complete here or through other substations)
Load break switch normally closed
Load circuits
Limiters or breakers

Fig. 17—Most common secondary network in industrial plants is shown here with a selective primary. Transformer or feeder faults cause load to be carried by secondary loop on half the primary system until fault can be isolated or cleared

Secondary load circuits

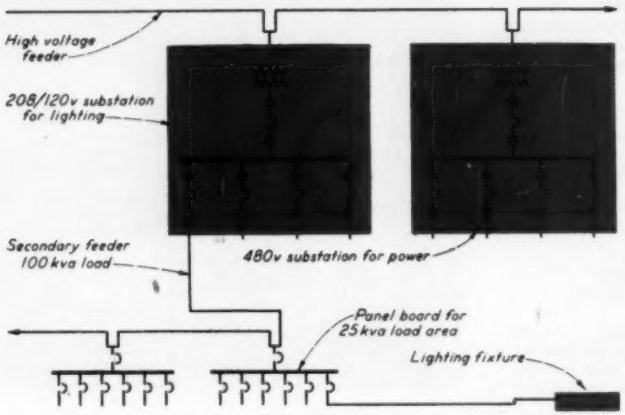

High voltage feeder
208/120v substation for lighting
480v substation for power
Secondary feeder 100 kva load
Panel board for 25 kva load area
Lighting fixture

Fig. 18—Separate light and power systems are seldom necessary, are most costly

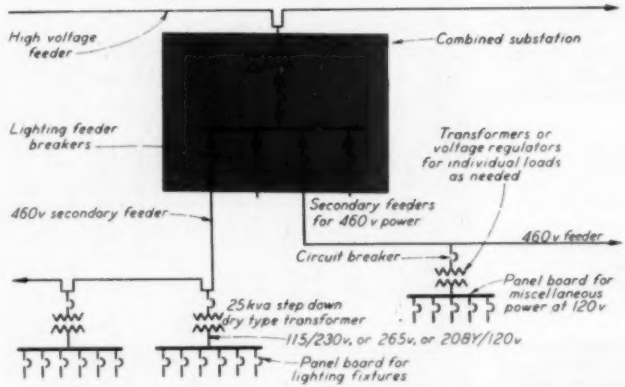

High voltage feeder
Combined substation
Lighting feeder breakers
Transformers or voltage regulators for individual loads as needed
460v secondary feeder
Secondary feeders for 460 v power
460 v feeder
Circuit breaker
Panel board for miscellaneous power at 120v
25 kva step down dry type transformer
115/230v, or 265v, or 208Y/120v
Panel board for lighting fixtures

Fig. 19—Spot transformation permits a combined system at reasonable expense

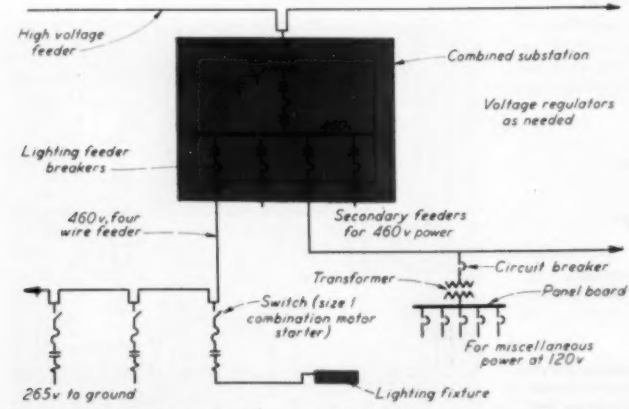


Fig. 20—265 v fluorescent lighting is most satisfactory for general work areas

Preceding sections which discussed substation size and secondary distribution voltage pointed out the desirability of combining lighting and low voltage power circuits in the same substations that supply the bulk of the power at 440 v (or 550 v). Principal problems involved are cost, circuits, and effect of power loads on lighting and other utilization devices for which constant voltage is preferable.

The separate substation method is illustrated in Fig. 18 primarily as a basis for comparison. When this system is used, light-duty load centers with molded case breakers are popular.

There are, of course, cases where lighting load becomes an appreciably large percentage of total load, or where it is important that light and power supplies be separated either because of safety or the effect of power variations on the lighting circuit. Then the normal procedure of connecting both substations on the same feeder, as illustrated in Fig. 18, is not always satisfactory, both because of voltage variations on the primary circuit and because of incomplete service reliability. Advisability of an entirely separate primary system should be considered.

Circuits for supplying low voltage power for lighting and miscellaneous uses from the same load center substation that supplies the heavier loads at 440 v are shown in Fig. 19. The main lighting load is distributed throughout the area on the small 460 v, three phase feeder. Small dry-type transformers reduce voltage to 115/230 v, 265 v or 208Y/120 v for single and three phase systems as desired. Other low voltage power may be taken from any convenient 460 v feeder with adequate capacity by spot transformation.

Investment for the system shown in Fig. 19, including fixtures, panels dry-type transformers and substation equipment (prorated on the lighting load) is only about $60.00 per kva as compared to about $86.00 for the separate substation as in Fig. 18.

The system in Fig. 20 is designed to supply the main lighting load at 265 v for the fluorescent lamps manufactured for that voltage. This is the most economical system for lighting general factory areas and brings the cost, on the same basis as before, down to about $47.00 per kva.

It is usually recommended that the small step-down transformers be not larger than 25 kva so that short-circuit currents on the secondary side will be low, allowing smaller interrupting devices for the utilization equipment.

Advantages for the use of spot transformation for small units are, for the most part, a repetition of those of the load center system. The low voltage areas may be sectionalized and lo-

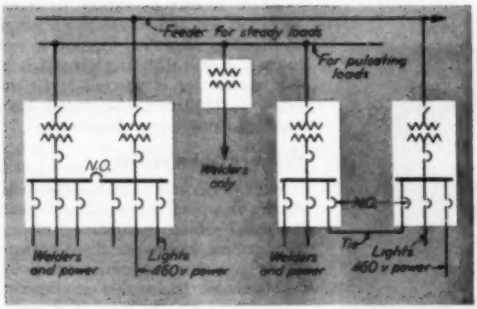


Fig. 21—Flicker buses on separate feeders reduce effects of pulsating loads. The secondary selective system is shown

Fig. 22—Small dry-type transformers can be located where needed to supply individual low voltage loads or circuits

Fig. 23—A 25 kva unit supplies a low voltage grinder from an efficient high voltage secondary distribution system

Fig. 24—Constant voltage supplied to individual loads as needed allows economies in design of the distribution system

cated where needed. The heavier low voltage lines are kept to minimum length and power is transmitted over the longer distances from the supply (substation) on small, high voltage lines. Although the unit cost per kva of low voltage power as supplied by the small step-down transformers is quite high for the smaller sizes, the small number makes overall cost low.

When converting an old system, not only cost of the substation itself, but investment and operating economies for 440 v utilization equipment will mean considerable savings over installation of a lower voltage system. Furthermore, existing cables and buses, if they can be operated at the higher voltage, will have greater capacity, relieving overloaded lines, avoiding new installations and, at the same time, reducing voltage drop. These savings and better service will often justify purchase of dry type transformers.

Voltage Variations

Good regulation is one of the important advantages of the load center system. However, enough impedance is usually retained or provided in each circuit to limit fault currents to a value that can be economically interrupted. Generally most circuit impedance is in the transformers, there being 3 to 5 per cent in both the main and load center units. Under normal conditions, the voltage span never-the-less remains within the efficient operating range for most utilization equipment.

In some instances, intermittent or pulsating loads will cause voltage dips which will either be annoying or detrimental. At certain frequencies of operation, dips of only 1 or 2 percent, such as caused by welders, produce noticeable flickering of lights. Frequent starting of heavy motors is another common offender. One method of avoiding the effects of pulsating loads is to connect them to "flicker" buses on a separate primary line, Fig. 21.

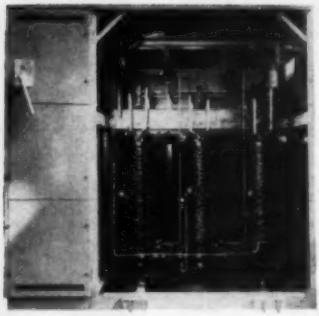
Some forms of equipment need a constant voltage. This is particularly true for instrumentation and inspection equipment and for power used for the supply or input to apparatus that is an inherent amplifier, including speed and other regulating devices, electronic panels, and the like. Even though the distribution system is designed to nullify variations produced within the plant, the voltage of the plant supply will vary between peak and low-load periods unless corrected by large plant or feeder voltage regulators.

Common practice is to install small sizes of voltage regulating apparatus for the isolated equipment or circuits as necessary, or where advisable for more efficient operation. Regulators are available as part of, or for installation in, the substation enclosure, or as separately packaged units. Since some forms will also reduce voltage, they can often provide spot transformation as well as regulation.

Motor driven regulators, with a response time measured in seconds, or fractions of seconds, are supplied in induction types and variable autotransformer types in capacities up to 100 kva for input voltages below 600 v. Instantaneous types, with response times down to 1 or 2 cycles, usually contain a saturating reactor-capacity circuit, a purely electronic circuit or a combination of the two. These are normally limited to the smaller (about 5 kva) sizes and are often used where voltage flicker is objectionable.

Transformers

DRY TYPE



Primarily suited for indoor installation.
Low impulse level, not for systems subject to lightning.
Lightest in weight, preferred on balconies.
No liquid system to maintain.
Dusty locations cause excessive maintenance.

Class A Insulation:
Inflammable, subject to moisture.

Class B Insulation:
Non-inflammable except binder, minor code restrictions, subject to moisture.

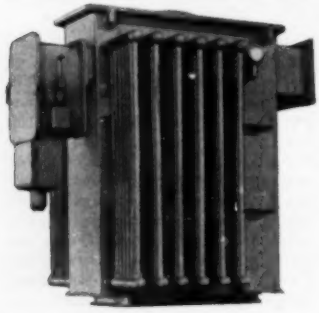
Class H Insulation:
Non-inflammable and resistant to moisture.

NITROGEN COOLED DRY TYPE

Most of the advantages of straight dry type.
Can be installed anywhere except on systems subject to lightning.
Sealed tank, slightly heavier.
Minor maintenance on nitrogen pressure system.
Non-inflammable, few code restrictions.
Unaffected by dirt or moisture, use in dusty locations or outdoors.
Class B or Class H insulation.

ASKAREL FILLED TYPE

Good impulse resistance, stand lightning surges well.
Can be installed anywhere.
Used for both primary and secondary substations.
Minor code restrictions, needs no vault, but requires some ventilation provisions.
May be used in semihazardous locations.
Not affected by moisture, dust or most corrosive conditions.
Available with radiators, forced air cooling and water cooling.
Heavy and needs good support.
Askarel system requires some maintenance.



OIL FILLED TYPE

High impulse resistance, stand lightning surges well.
Often preferred for primary substations located outdoors and connected to high voltage lines exposed to lightning.
Not affected by dirt, moisture or most corrosive conditions.
Requires vaults for indoor installations.
Heavy, requires good support.
Relatively high maintenance because oil sludges, requires protection from air.
Available with radiators, forced air cooling and water cooling.

There is enough variety in transformer types, and so much advantage in choosing substation location to suit the area served that, as a general rule, the transformer is selected to fit the location. Modern developments have removed many former limitations.

Primary Substations

Utility lines supplying the main substation of a plant are usually overhead lines and subject to lightning surges. Furthermore, because of the high supply voltage, transformers are often located outdoors. In this application, conditions favor the oil cooled transformer and it is extensively used, particularly in the larger plants.

Askarel cooled units are also popular, especially in small and medium sized plants, where the same cooling medium is used for the load center units, simplifying maintenance. Askarel creates no fire hazard and does not sludge.

Air cooled transformers are not yet common in main substations, with exceptions such as small plants in metropolitan areas where incoming lines are protected from lightning.

Total capacity depends on plant load plus anticipated expansion and reserve capacity. Modern recommendations call for the use of three phase units, with total capacity divided between enough transformers to keep fault currents within reason and to supply minimum loads when a unit fails.

Secondary Substations

Oil filled units are seldom recommended unless vaults or outdoor locations are available or must be provided for other purposes.

Dry type transformers appear to be most popular for indoor installations. Either is acceptable, barring lightning exposure or atmospheric conditions which favor the askarel type. Final choice is usually based on the respective advantages for the proposed location and on flexibility for future plant changes.

Capacity is based on the load center size plus the extra capacity needed to cover expansion, peak loads and the reserve (determined for individual plant conditions) needed in case of failure of one transformer.

Normal recommendation for expansion is to allow about 25 per cent extra capacity for immediate additions. Flexibility of the load center system permits addition of individual units for increases beyond this value. A common practice is to install a single ended substation to handle present loads and, when demand justifies it, add another transformer (with necessary switchgear) to make a double ended unit.

Primary substation switchgear

Main substations vary, according to individual needs, from a single feeder unit supplying one or more load centers to larger units, Fig. 25, consisting of several interconnected bus sections which may carry generators and motors as well as utility and feeder circuits.

Manufacturers offer a wide selection of standard compartments and switchgear components which are combined and pre-wired for any requirement. Empty compartments, or floor space for extra sections at the end of the switchgear will allow for expansion.

First consideration will be location. Incoming voltages above 15 kv almost automatically mean the transformers will be located outdoors. Availability of weatherproof switchgear enclosures has made complete outdoor sub-stations popular, even at the lower voltages. Often however, switchgear is preferred inside for convenience and may be connected to outdoor transformers by short, enclosed bus runs.

Voltage Control, Grounding

When selecting transformers for the main substation, desirability of maintaining constant voltage on the primary system should be considered. The cheapest equipment is usually load ratio control, which adjusts transformer output voltage to compensate for variations caused by changing load. The possibility of wye-wound secondaries with bushing for neutral grounding should also be considered.

Switchgear is the metal clad (as opposed to metal enclosed) type. Power breakers for industrial use normally have an 8 cycle operating time.

Connections for many primary substations will be similar to those of simple radial load center units, with one incoming line. Others will have two incoming lines and connections of the secondary selective type to reduce interrupting capacity, or of the spot network type, which is more independent of load diversity. Preliminary selection of breakers for these circuits will be fairly simple.

Power circuit breakers have certain limits which should not be exceeded. To do so, even in preliminary estimates, might mean major revisions in specifications for the substation. Principal factors are listed in Table 8.

In the simpler systems, the immediate problem will be determination of interrupting capacity. It will be necessary to know short-circuit capacity of the incoming line (obtained from the utility) and the size and per cent impedance of primary transformers.

In a system where generator and motor loads can be neglected, interrupting duty of main and feeder breakers is substantially equal to the kva that would flow if the secondary of the transformer were shorted. The usual method of calculation refers all capacities to a given base value of kva. However, the following method is often easier for quick calculations.

Assuming that utility line capacity is infinite, the short-circuit kva delivered on the secondary of one or more paralleled transformers is:

kva = total rating x 100/per cent impedance

However, incoming line short-circuit capacities commonly encountered will be limited to the extent that they will reduce the above value appreciably. The actual value will be, using mva for convenience:

$$(1) \qquad mva = \frac{(mva)_1 \times (mva)_2}{(mva)_1 + (mva)_2}$$

Where mva is the resultant short-circuit duty in millions of volt-amperes, $(mva)_1$ is the short-circuit capacity of either transformer or utility line and $(mva)_2$, the capacity of the other.

Short-circuit capacities of generators and motors bear the same relation to rated capacity as short-circuit current (use transient or subtransient impedance as necessary) to rated full load current. Where such equipment is connected directly (not through transformers, reactors or appreciably long lines) to the bus feeding the fault, their short-circuit contributions may be added directly to the interrupting duty calculated as above. See also page 93.

Where transformers or other impedances, Fig. 25, are in series with the equipment, the capacity of the impedance alone may be found just as that of the primary transformer was calculated. Per cent impedance at a given load is used. The resultant contribution of the equipment to the fault is found from formula (1). Note that since kva capacity is the same on both primary and secondary sides of a transformer, transformation ratios do not enter the calculations.

Induction motors act as generators immediately after a short circuit just as synchronous motors do. However, the current disappears after one to three cycles and does not affect interrupting duty; therefore it is not usually included in the calculation for the common 8 cycle power breaker. However, if appreciable horsepower of motors is connected, their short-circuit output must be added when considering momentary current limits. Short-circuit kva for motors is approximately the same as *full voltage* starting kva.

Because current varies directly as the kva, momentary current will usually be within the limit if total interrupting duty plus induction motor contributions does not exceed 1.6 times the interrupting kva capacity of the breaker.

TABLE 8—PRINCIPAL LIMITS IN POWER BREAKER APPLICATION

1. Interrupting kva (or mva), or the total three phase kva passing through a breaker when it opens to clear a fault.
2. Maximum interrupting amperes, which is the current based on maximum interrupting kva at minimum voltage for maximum interrupting kva.
3. Momentary current, which includes short time transients such as motor feedback even though they disappear before the breaker opens. In standard ratings, this limit is 1.6 times interrupting amperes, allowing for asymmetric current, but not induction motor contributions.
4. Maximum operating voltage, including highest value used for regulation.
5. Minimum voltage for rated interrupting kva, see item 2, above.
6. Continuous current rating, most likely to be exceeded in main breaker.

TABLE 9 — BREAKER SIZES AND OPERATING LIMITS

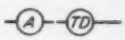
Three phase interrupting capacity, mva	Voltage ratings: Rated kv	Maximum design kv	Min. kv for rated IC	Current ratings, amp: Continuous 60 c value	Momentary	Four second	Interrupting ratings, amp at: Rated voltage	Maximum
50	4.16	4.76	2.3	600-1200	20,000	12,500	7000	12,500
150*	4.16	4.76	3.5	600-1200	40,000	25,000	21,000	25,000
150*	4.16	4.76	3.5	2000	40,000	25,000	21,000	25,000
250**	4.16	4.76	3.85	1200	60,000	37,500	35,000	37,500
250**	4.16	4.76	3.85	2000	60,000	37,500	35,000	37,500
250	7.2	8.25	4.6	1200	51,000	32,000	20,000	32,000
250	7.2	8.25	4.6	2000	51,000	32,000	20,000	32,000
500	7.2	8.25	4.6	1200	70,000	44,000	40,000	44,000
500	7.2	8.25	4.6	2000	70,000	44,000	40,000	44,000
150	13.8	15.0	6.6	600-1200	20,000	13,000	6300	13,000
250	13.8	15.0	6.6	1200	35,000	22,000	10,600	22,000
250	13.8	15.0	6.6	2000	35,000	22,000	10,600	22,000
500	13.8	15.0	11.5	1200	40,000	25,000	21,000	25,000
500	13.8	15.0	11.5	2000	40,000	25,000	21,000	25,000

*Dual rating, IC reduced to 100 mva at 2.4 kv **Dual rating, IC reduced to 150 mva at 2.4 kv

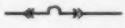
Incoming line switchgear

METERING AND RELAYING

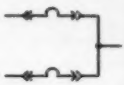
Applied as needed for individual conditions.

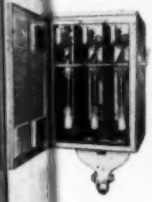


CIRCUIT BREAKERS



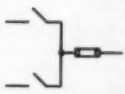
Maximum flexibility with automatic switching, remote control.
Safest for personnel.
Highest in cost (but often eliminates need for main secondary breaker).
Best circuit protection (no single phasing, etc.).
Common maximum interrupting ratings:
150 mva at 2500 v.
250 mva at 5000 v.
500 mva at 15 kv.





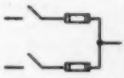
FUSED DISCONNECT OR SELECTOR SWITCHES

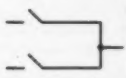
Manual switching.
Transformer disconnects.
Primary feeder selection.
Overload protection.
Short circuit protection.
Common maximum interrupting ratings:
150 mva at 2500 v to
500 mva at 15 kv.

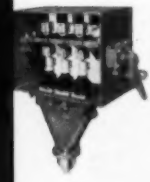


OIL CUTOUTS

Manual switching.
Commonly used as transformer disconnects.
May be used for feeder switching.
Fused:
Short circuit and overload protection.
Ratings limited to small units;
300 kva or smaller transformers.
5000 v or less.
50 mva interrupting capacity or less.
Unfused:
Switching only.
Ratings to 1000 kva at 5000 v.

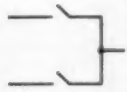






LOAD BREAK SWITCHES

Manual switching.
Transformer disconnects.
Primary feeder selection.
Ratings for all load center sizes.
Require back-up protection.
Also available in magnetizing current break.
Switches to be interlocked with secondary breakers.

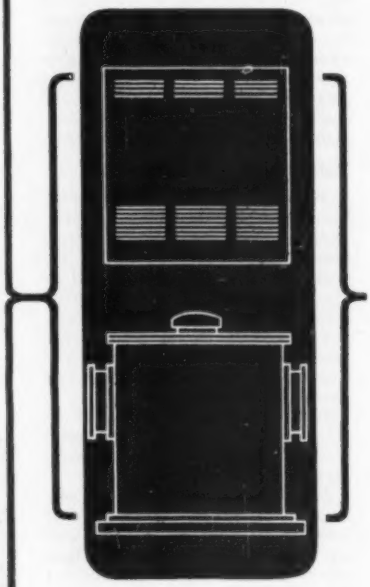


JUNCTION BOXES

Used when protection and switching are elsewhere.

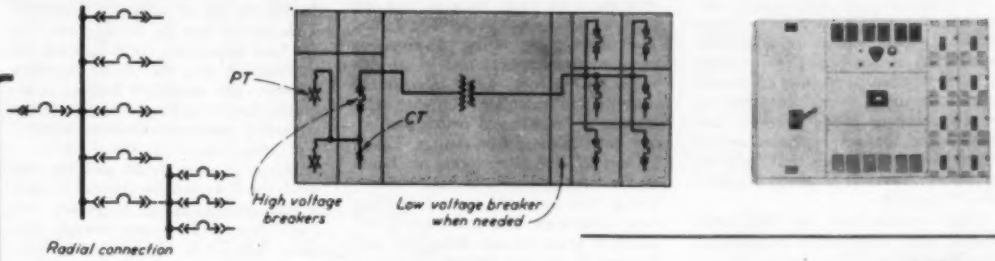
Selection of load center switchgear must be coordinated with the primary feeder system and the secondary feeder circuits and with due consideration to utilization requirements, if minimum expenditure is to provide necessary reliability and flexibility.

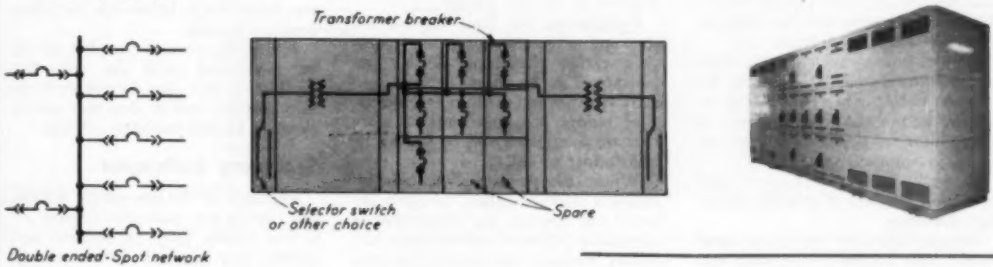
Primary breakers, similar to main substation power breakers, are often advantageous where automatic relaying or remote control can reduce or eliminate outage time in critical areas. Where the reliability needed does not require the investment, or is insured by other means, such as secondary loops or tie feeders, the less expensive primary switches are recommended. Oil or askarel immersed switches are normally mounted on liquid cooled transformers. Breakers and air immersed switch enclosures match air cooled transformer and metal enclosed switchgear housings. Interrupting requirements are similar to those of main substation switchgear, but may be reduced by impedance of long primary feeders.

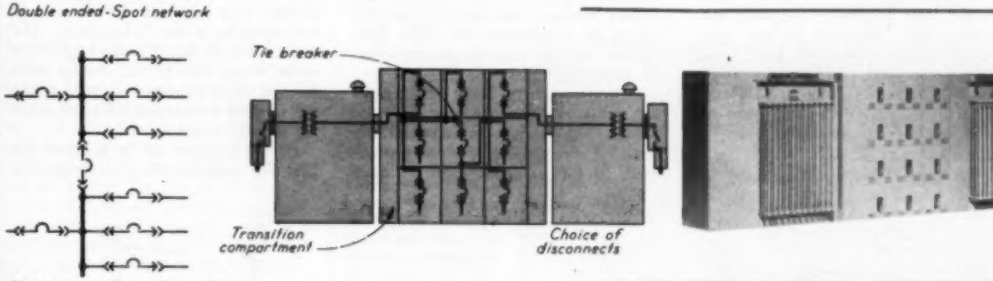


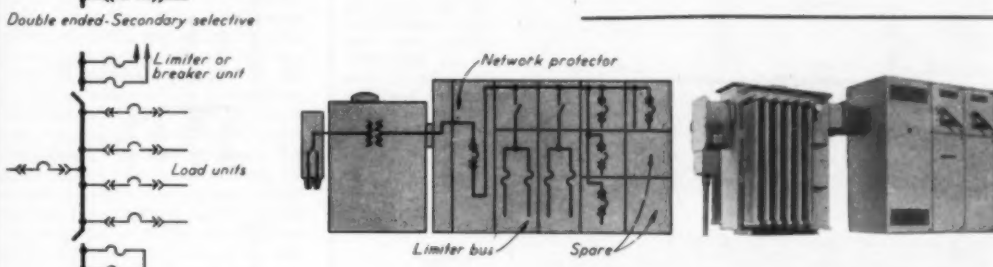
Secondary switchgear may consist (as necessary) of main breakers, network protectors, tie breakers, main feeder breakers and breakers employed for infrequent motor starting. Present practice seems to favor fewer main feeder breakers with less expensive, smaller breakers connected in cascade in the substation and in motor control centers and the like.

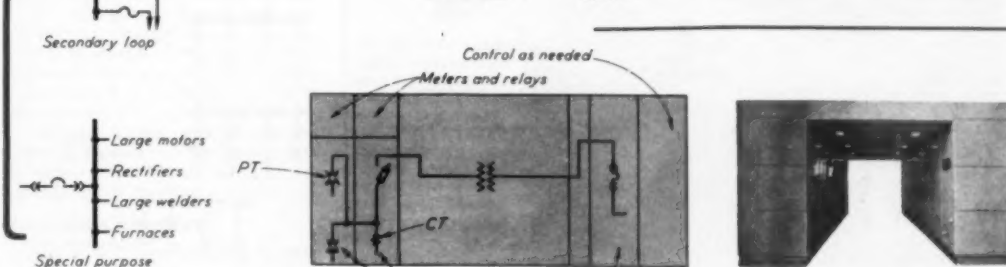
Secondary switchgear variations











Load center switchgear

Arrangements of load center substations, consisting of two distinct types of switchgear as well as the transformer, are just as flexible as for primary units. Expansion in number of circuits is provided for by empty compartments to accommodate added breakers and floor space for new sections and/or transformers. Metering and relaying equipment may also be added at a later date if desired.

Once location and size have been chosen, there remains the problem of selecting primary switchgear and of determining number and size of breakers for the utilization feeders.

Type of primary switchgear is determined in the final selection of the distribution circuit, and is chosen for reliability and speed of restoration of power after an outage which is considered economically feasible.

Tables 8, 9, 10 and 11 give typical sizes and capacities of primary switchgear available.

Ratings, Tables 8 and 9, are based on the same factors as for main substation units. Breakers are the same 8 cycle, power type units. Load break disconnect and selector switches, Table 10, and oil cutouts, Table 12, can switch load currents only but are rated for momentary currents in the same manner as breakers.

The fused type switches and cutouts will interrupt fault currents and are rated as before except for one factor. The interrupting rating is given as asymmetrical amperes instead of rms values. Therefore, fuse interrupting currents are calculated in the same manner as breaker and switch momentary duty. Because fuse ratings, Tables 11 and 12, for interruption are based on the first half cycle of fault current, this is true even for current limiting fuses. However, kva interrupting capacity is given in rms values to correspond to breaker ratings.

Calculations for fault currents are the same as for main substation switchgear except that more feeder impedance, Fig. 25, exists between primary switches and the source. Required load ratings are quite definite since they are determined only by size of the transformer served.

Where the primary switchgear includes a power breaker, properly selected and applied, the transformer is adequately protected and the main secondary breaker is not required for protection in compliance with NEC. This system also provides the greatest overall flexibility.

However, where many small units are connected to one feeder, Fig. 25, breakers may not be economically justified and switches are more often used. In this case, the Code requires that the primary feeder breaker be set to trip at not more than six times the rating of the smallest load center transformer on any of the primary feeders. This insures that the breaker will trip for high impedance faults between the transformer and the main secondary breaker. The secondary breaker is required to give backup protection to the secondary feeder breakers and overcurrent protection to the transformer.

When primary fused switches are used, the fuse must be selected to have a low enough rating to protect the transformer and yet have enough time delay that it will not open on secondary feeder faults before the secondary breakers operate.

Preferably, primary switches should be interlocked with the secondary breakers so that they do not interrupt load currents and so that they cannot close on loaded secondary circuits.

Secondary Switchgear

Breakers for the low voltage secondary circuits are generally divided into two classes, large air breakers and molded case breakers (whose ratings overlap those of the air breakers). The first class is preferred in the load center units while the latter, usually with thermal trips, is sometimes used in the the smallest substations but more often for branch circuit service.

Before breakers can be selected, the first and probably the most important

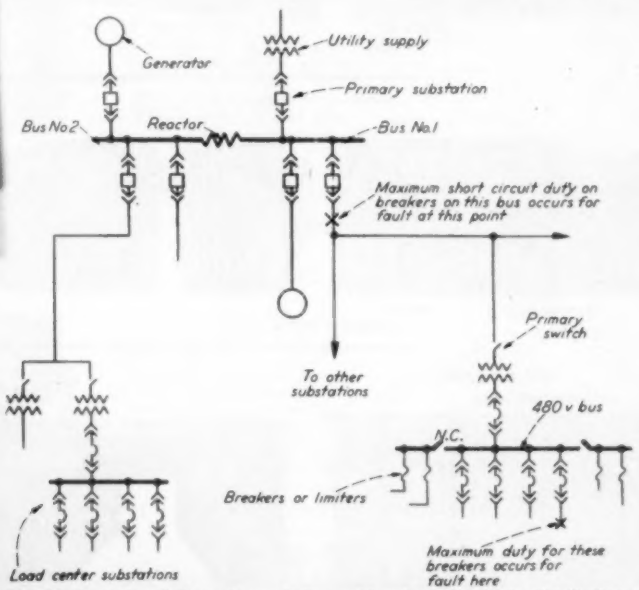


Fig. 25—Capacity of the various switches and breakers used in the distribution system to interrupt fault currents is important. Feedback from motor loads is added to short-circuit capacity of source. Long feeders reduce load center requirements

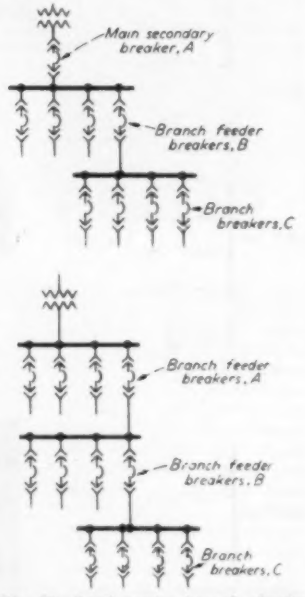


Fig. 26—Load center branch circuits take two forms which are of interest in the cheaper cascade form of operation

TABLE 10—LOAD BREAK SWITCH RATINGS FOR USE WITH VARIOUS TRANSFORMER SIZES

Voltage, kv	500 kva, amp	600 kva, amp	750 kva, amp	1000 kva, amp	1500 kva, amp	2000 kva, amp
2.4	200	400	400	400	600*	800*
4.16	200	200	200	400	400	600*
4.8	200	200	200	200	400	400*
7.2	200	200	200	200	200	400
12.0	200	200	200	200	200	200
13.2	200	200	200	200	200	200

*Magnetizing current break only.

TABLE 12 — TYPICAL OIL FUSE CUTOUT RATINGS

Circuit voltage, kv	Voltage rating, kv	Maximum current, amp	Interrupting capacity, rms amp	Interrupting capacity, 3 phase mva
2.4	4.33	100	6000*	15
		200	11,000	28
		300	11,000	28
4.16	4.33	100	6000	27
		200	11,000	50
		300	11,000	50
4.8	5.0	100	5000	26
		200	10,000	50
		300	10,000	50
7.2	7.5	100	3750	29

Load break ratings are reduced below maximum current rating at 5000 and 7000 v.

TABLE 11 — INTERRUPTING RATINGS, FUSED LOAD BREAK SWITCHES

Voltage class, kv	Nominal voltage, kv	Interrupting capacities: Asymmetrical rms amp	Interrupting capacities: Equivalent 3 phase mva	Maximum trans. kva
5	2.4	10,000	26	375
		17,500	45	375
		30,000	78	750
		40,000	150	375
5	4.16	10,000	45	375
		17,500	78	750
		30,000	135	1500
		40,000	250	750
5	4.8	5000	26	375
		17,500	91	750
		30,000	186	1500
		40,000	250	750
7.5	7.2	15,000	112	1250
		25,000	186	2000
		80,000	500	625
15	12.0	12,500	162	2000
		20,000	259	2000
		50,000	500	1000
15	13.2	12,500	179	2000
		20,000	286	2000
		50,000	500	1000

Current limiting fuses are employed for 50,000 amp and up.

decision will be on use of either selective tripping or cascade operation of the breakers. Fig. 26 illustrates methods of connecting branch feeders. The principal branch switchgear will probably be in the load center itself, the rest may be in motor control centers and the like at the end of fairly long feeders with appreciable impedance.

In the selective system, breaker trips are timed so that the one nearest the fault and farthest from the transformer trips first. Thus, a fault on a motor would trip only its branch feeder, and a fault on a branch feeder bus, only the breaker supplying that bus, leaving all other circuits in operation. However, all breakers must be able to interrupt the full short-circuit current available at their load terminals. For example, in a 1000 kva substation, the secondary short circuit current, including motor contributions, may be 32,000 amp, requiring a 50,000 amp breaker. All branch feeder breakers at the load center will have to be the same size. However, branch breakers, C, Fig. 26, may be at the end of a long feeder with sufficient impedance to reduce a short-circuit current at the breaker to within the capacity of a 25,000 amp size.

Although most costly, selective tripping is preferred for services such as station auxiliaries and for plants requiring highly continuous service.

Cascading Breakers

The same connections may be used in the cascade system but the method of rating breakers is different. Breakers connected directly to the transform-

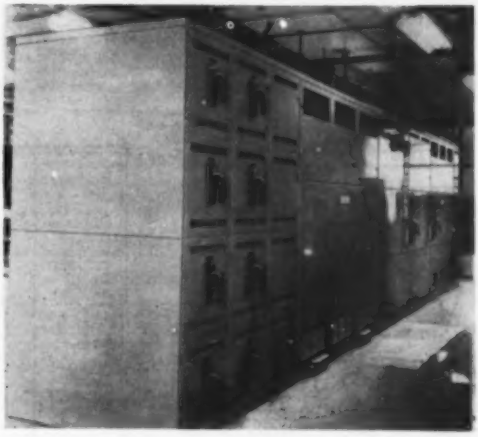


Fig. 27—Substation assemblies are made up of basic units assembled to supply known requirements. This double-ended unit has the primary switches in the center, dry-type transformers next, and low voltage switchgear at the ends to allow for additional circuits

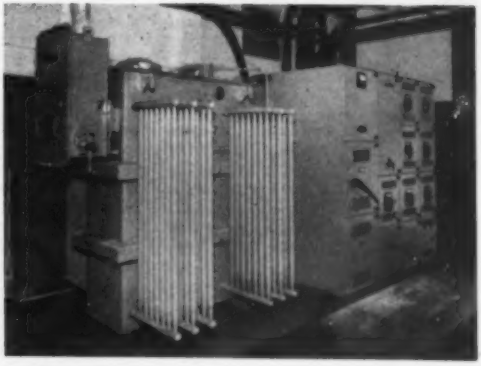


Fig. 28—This single ended substation has a selector switch with a double pothead on the primary side. Secondary compartments may include meters and relays, tie cable switches and feeder breakers as required

TABLE 13 — INTERRUPTING REQUIREMENTS FOR LOW VOLTAGE BREAKERS

Transformer rating	Available short-circuit primary mva	600 v: Full load current, amp	600 v: Short-circuit current, amp: Transformer alone	600 v: Short-circuit current, amp: 100 per cent motor load	600 v: Short-circuit current, amp: Combined	480 v: Full load current, amp	480 v: Short-circuit current, amp: Transformer alone	480 v: Short-circuit current, amp: 100 per cent motor load	480 v: Short-circuit current, amp: Combined	240 v: Full load current, amp	240 v: Short-circuit current, amp: Transformer alone	240 v: Short-circuit current, amp: 100 per cent motor load	240 v: Short-circuit current, amp: Combined	208 v: Full load current, amp	208 v: Short-circuit current, amp: Transformer alone	208 v: Short-circuit current, amp: 50 per cent motor load	208 v: Short-circuit current, amp: Combined
300	50	389	6,482		7,795	361	8,998	1,680	10,780	722	16,166	3,360	19,720	834	19,690	3190	22,880
5%	100		6,850	1460	8,360		8,850		10,380		17,000		20,680		20,380		23,570
	250		7,060		8,560		9,060		10,680		17,660		21,280		20,980		24,160
	Unlimited		7,210		8,700		9,200		10,800		18,100		21,700		21,400		24,580
450	50	433	9,080		11,280	842	11,980	2,520	14,500	1083	22,990	5,040	28,300	1250	28,000	3180	31,780
5%	100		9,580	2200	12,100		12,480		15,100		24,000		29,280		28,980		32,580
	250		10,480		12,680		13,080		15,700		26,080		31,480		31,100		34,980
	Unlimited		10,800		13,000		13,500		16,200		27,000		32,400		32,000		35,980
500	50	481	10,080		12,480		12,980		15,580		25,160		31,160		28,980		32,480
5%	100		11,080	2480	13,480	660	13,780	3,080	16,780	1200	27,380	6,880	34,280	1380	31,980	3860	35,880
	250		11,680		14,080		14,580		17,380		28,980		34,960		33,380		36,980
	Unlimited		12,080		14,480		15,180		18,180		30,160		36,160		34,680		38,160
600	50	578	11,680		14,580		14,680		18,280		29,080		36,280		33,980		37,780
5%	100		12,980	2980	15,980	722	16,180	3,680	19,780	1443	32,180	7,280	39,380	1660	37,180	4280	41,280
	250		13,880		16,780		17,280		20,880		34,680		41,680		39,780		43,980
	Unlimited		14,580		17,480		18,180		21,780		36,080		43,260		41,780		45,980
750	50	722	12,980		16,580		16,180		20,680		32,380		41,380		37,180		42,280
5½%	100		14,080	3680	18,180	960	18,080	4,580	22,580	1880	36,180	9,280	45,180	2080	41,680	5280	46,880
	250		15,080		19,280		19,080		24,080		39,080		48,080		44,080		50,080
	Unlimited		16,480		20,080		20,080		25,080		41,180		50,180		47,280		53,080
1000	50	962	16,180		20,980		20,180		26,180		40,280		52,280		46,280		53,280
6½%	100		18,580	4880	23,280	1280	23,280	6,080	29,280	2400	46,280	12,080	58,280	2780	53,480	7080	60,480
	250		20,180		25,280		25,280		31,880		51,080		63,880		58,980		66,980
	Unlimited		21,980		26,780		27,480		33,480		54,780		66,780		63,280		70,280
1500	50	1444	21,380		28,280		26,680		35,680		53,280		71,280		....		....
8½%	100		25,980	7280	33,180	1800	32,280	9,080	41,280	3600	64,080	18,080	82,080		....		....
	250		29,780		36,980		37,080		46,080		74,080		92,080		....		....
	Unlimited		32,980		40,180		41,180		50,180		82,080		100,080		....		....
2000	50	1924	28,380		34,980		33,980		42,780		....		....		....		....
8½%	100		31,680	9680	41,280	2400	39,480	12,080	51,480		....		....		....		....
	250		37,580		47,180		46,880		59,880		....		....		....		....
	Unlimited		43,980		53,480		53,780		66,780		....		....		....		....

Short-circuit contributions by motors are five times full load current. Computations include a factor of 1.25 for d-c component.

TABLE 14—TYPICAL LOW VOLTAGE BREAKER RATINGS & NUMBER PER VERTICAL SECTION

Interrupting current, amp	Continuous current, amp	Operation	Breakers per section
15,000	25-225	Manual	3
15,000	25-225	Electric	3
25,000	50-600	Manual	3
25,000	50-600	Electric	3
50,000	200-1600	Manual	3
50,000	200-1600	Electric	2
75,000	2000	Electric	2
75,000	3000	Electric	2
100,000	4000	Electric	1

Most manufacturers also supply four-high sections in the smaller sizes of breakers.

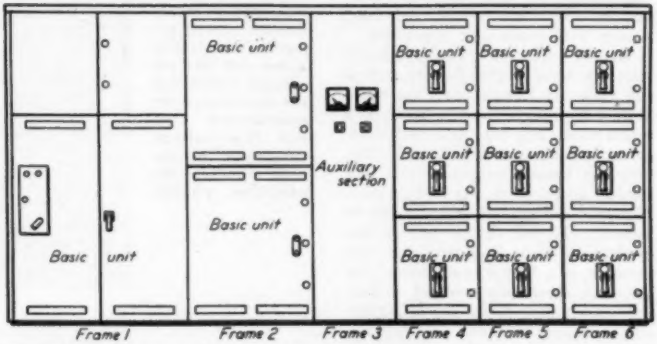


Fig. 29—Switchgear assemblies are built up of basic units sized to accommodate the various breaker ratings listed in Table 14. Auxiliary sections are needed for bus transitions between units of varying height and for mounting meters and relays

er (A in Fig. 26) must be rated for the full interrupting capacity, or 50,000 amp in the above example. The breaker must have an instantaneous over-current trip adjusted to operate at 80 per cent of the interrupting capacity. Then branch breakers, B, in both circuits may be chosen so that interrupting capacity is adequate for only one-half the actual short-circuit current, and capacity of breakers, C, greater than only one-third. Thus the 25,000 amp size for breakers, B, would be needed to interrupt one-half of the 32,000 short-circuit amp in the example, and the 15,000 amp size for breakers, C, for the one-third figure. The 80 per cent setting of the main breaker insures that both will trip.

Independently of the interrupting rating, full load current, especially in the main breaker, may require the next larger size.

Breakers used in cascade must be of the same general type. Thermal breakers cannot be used with magnetic types, and NEMA ruling prohibits use of plastic case breakers cascaded (used above rated capacity) with magnetic types. Also there is a limitation of the number of synchronous motors.

The cascade system saves considerable investment, but all service supplied through the main breaker is lost until the breaker can be reclosed after a fault on the load center circuit.

Breaker Capacities

Basically, interrupting requirements for secondary breakers are calculated in the same manner as for primary circuits. However, in low voltage circuits (600 v or less), breakers are designed for instantaneous operation and therefore must be able to interrupt the first half cycle of fault current. Since this may include the worst transients, momentary duty is the same as interrupting duty.

On the other hand, ratio of resistance to reactance is higher, transients die out more rapidly, and a factor of only 1.25 has been found adequate to multiply symmetrical values to obtain the maximum asymmetrical currents upon which interrupting duty is rated.

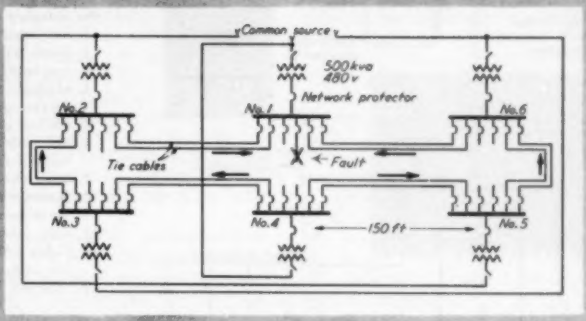
Motor feedback is normally based on a 100 per cent connected load in the higher voltage systems. Although actual motor kva capacity generally exceeds that value, it has been picked as a safe average to use in calculations. Further, an average value of impedance, 20 per cent, including that of the feeders, has been selected, so that low voltage motor contributions to a fault are taken as five times full load transformer current. On 208 v systems, which are primarily used for lighting, motor load is generally taken as 50 per cent of full load current.

These factors have been combined into tabular form, such as Table 13, and to find interrupting duty, it is only necessary to know substation rating, impedance and source capacity (either kva or per cent impedance on a given base. The interrupting capacity of the source breakers is sometimes used). Note that transformer short-circuit currents are listed in asymmetrical amperes, including the 1.25 factor, and that motor contributions are added to give the combined, or total, fault currents in the next column.

Where the bulk of the load on a substation is incapable of feedback, as with resistance welders, furnaces, etc., only the transformer short-circuit current value is used.

The tables are satisfactory for radially connected load centers, which includes the majority of cases. Where secondary loops or ties are used, currents from connected substations also flow to the fault although limited by tie cable impedance. Normally, loop currents are calculated by setting up an impedance network, or by the use of calculating boards. However, the method previously given in the section "Primary Substations" may be used for combined fault currents as shown in the box at the right with a considerable saving in time.

The method is theoretically accurate although, as with other systems, source



FAULT CURRENTS IN LOOP OR TIE CIRCUITS

Currents as in Table 13 are proportional to kva (or mva). For a given voltage, formula (1),

$$mva = \frac{(mva)' \times (mva)''}{(mva)' + (mva)''}$$

can be stated

$$a = \frac{a' \times a''}{a' + a''} \text{ (formula 2)}$$

Where

a' = short-circuit current of a source for zero impedance fault (such as the combined currents, Table 13)

a'' = short-circuit currents that could be delivered by an impedance (such as the tie cable) alone if it were connected to an infinite bus at the same voltage, or

$$= \frac{\text{full load amp} \times 100}{\text{per cent impedance}}$$

a = value to which a' would be reduced by flowing through the impedance used in finding a''.

Kiloamperes may be used for convenience without affecting results. However, the factor, 1.25, for d-c component must be included in all currents, or excluded from all until the result is obtained.

EXAMPLE

In the diagram, six 500 kva, 480 v substations spaced about 150 ft apart are connected by a secondary loop. Tie cable reactance is taken as 0.7% on the same base, 500 kva, as the transformers. Utility capacity is 100 mva.

Full load current from Table 13 is 600 amp, or 0.6 ka, symmetrical, and does not include the 1.25 factor for d-c. Then

$$a'' = \frac{0.6 \times 100}{0.70} \times 1.25 = 107 \text{ ka}$$

This is the asymmetrical current that would flow if the cable were connected to a 480 v bus of infinite capacity. It is assumed to be constant for all tie cables in this example.

Since there are an even number of substations, the contribution of the one farthest from the fault will divide and flow down both sides of the loop. Therefore the original source is divided in Step 1:

STEP 1:

From Table 13, combined asymmetrical short-circuit current for substation is 18.1 ka for infinite source capacity and

$$a_1' = \frac{18.1}{2} = 9.0 \text{ ka}$$

Applying formula 2,

$$a_1 = \frac{9 \times 107}{9 + 107} = 8.3 \text{ ka}$$

This would be the contribution of one-half of No. 4 to a fault at No. 2, and combines with the capacity of No. 3 to become a' for the next step, or

$$a_2' = 8.3 + 18.1 = 26.4 \text{ ka}$$

STEP 2:

Again applying formula 2

$$a_2 = \frac{26.4 \times 107}{26.4 + 107} = 21.2 \text{ ka}$$

Similarly at center No. 2,

$$a_3 = 21.2 + 18.1 = 39.3 \text{ ka}$$

which again would be the fault current due to centers 2, 3 and 4 alone (for infinite source capacity) through a solid ground at No. 2. Since the actual ground is at No. 1, the value will be reduced as before by the final tie cable:

STEP 3:

$$a_3 = \frac{39.3 \times 107}{39.3 + 107} = 29 \text{ ka}$$

This is the fault current contribution for one side of the loop. The total for both sides and No. 1 substation itself is

$$29 + 29 + 18.1 = 76.1 \text{ ka}$$

This is the fault current for an unlimited source capacity, and must be calculated as such because the actual source impedance is in series with all substations involved.

The short-circuit current (on a 480 v base) which could be delivered by the source through zero impedance is

$$\frac{100 \text{ mva} \times 1000}{1.73 \times 480} \times 1.25 = 150 \text{ ka}$$

Finally, using formula 2 again to account for the source impedance,

STEP 4:

$$a = \frac{76.1 \times 150}{76.1 + 150} = 51 \text{ ka}$$

This is the actual fault current and compares to a value of 50,000 asymmetrical amp for the same example calculated by the network method.

The average tie cable reactance is usually sufficiently accurate. However, other values, including other impedances, can be substituted as necessary at the proper points.

UNEVEN NUMBERS OF SUBSTATIONS

Where an uneven number of load centers are connected in the loop, full short-circuit current capacity would be used for the center farthest from the fault. Other steps would be included as necessary.

TWO PARALLELED SUBSTATIONS

For two centers normally connected by a tie cable, only Step 1, using full capacity of the unfaulted center, and Step 4 are necessary. Step 4 could be eliminated without great error if the short-circuit capacities from Table 13 are based on source capacity (14.7 ka for the conditions of the example).

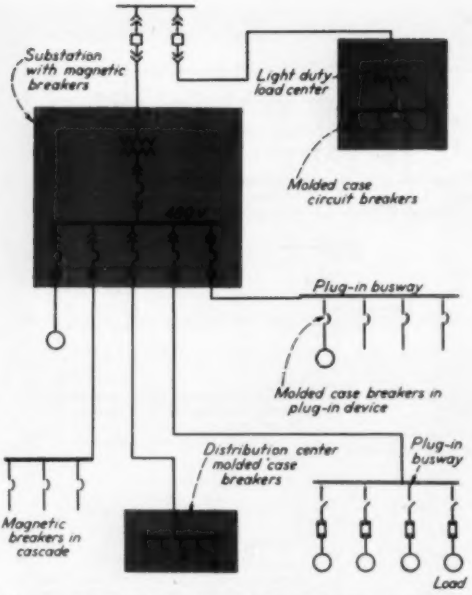


Fig. 30—A variety of switching and protective devices, located both in the substation and at the end of utilization feeders, help complete the secondary distribution system

TABLE 15—TYPICAL COMPONENTS IN BASIC UNITS

The complete unit is metal enclosed and may include:

1. Ventilated hinged door, usually not for mounting devices.
2. Large air circuit breaker, drawout type, with inverse time delay and instantaneous trips and with operating means.
3. Mechanical trip provision.
4. Breaker open-close indicator.
5. Position changing mechanism for removable element.
6. Mechanical interlock to prevent removable element from being inserted or withdrawn with breaker closed.
7. Main disconnecting devices.
8. Secondary disconnecting devices when required.
9. Set of buses adequate for total load in that section.
10. Bare copper bus connectors of same rating as breaker.
11. Cable terminals, cable clamps, ground bus, small wiring, control bus, and terminal blocks as required.
12. Current transformers for tripping (100,000 amp breakers).

TABLE 16—COMMON TYPES OF LOAD CENTER DEVICES

1. Standard air breakers for main bus and branch feeders.
2. Standard breakers, but used for infrequent motor starting.
3. Network protectors, or breakers which open on reverse power, automatically reclose when fault is cleared. Also fused.
4. Disconnect switches, often used in secondary networks with
5. Limiters, a type of fuse designed to protect cables.
6. Motor controllers, which employ contactors capable of frequent starting but not fault current interruption. Fuses are often included for fault protection. Controller sections for nearby heavy motors may be included in load center.
7. Molded case breakers, with thermal, (and often magnetic) trip. Interrupting rating cannot be exceeded for cascading.

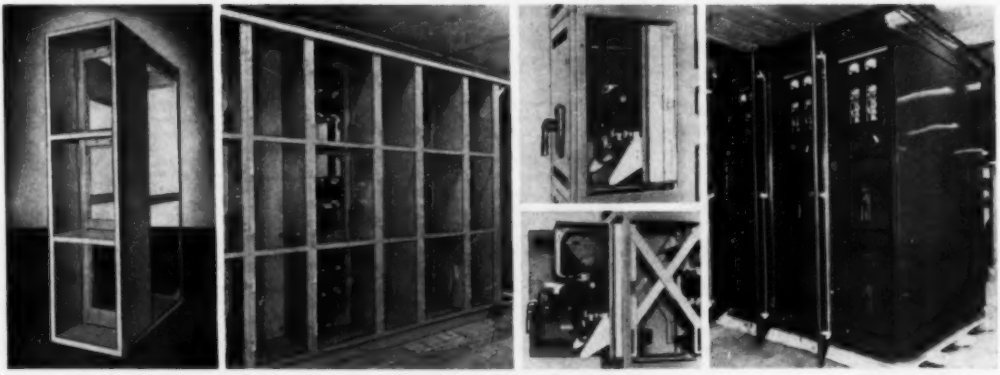


Fig. 31—These views show how frames and other standard components are assembled and connections completed so that only incoming lines and secondary feeders need be added. Removable elements simplify changes, maintenance

capacity, connected load and other factors are often only estimates and therefore affect the results. It makes direct use of the quantities such as short-circuit kva or amperes without preliminary transformations. Other values such as cable impedance are usually on hand in order to determine voltage regulation, etc. Note that it is unnecessary to change kva and reactance values to a common base as in other methods.

Only one basic formula* besides simple addition is used to attain a progressive combination of successive pairs of simple factors until the final answer is obtained. In most cases, only one or two steps are involved. The method can also be used to find interrupting duty at the end of a long feeder when such information cannot be obtained from tables.

On utilization circuits, resistance as well as reactance of cables must be considered in calculations. For the example in the box, ⅔ of the cable impedance was used as the reactance (about 25 per cent greater than the actual value), so as to agree with comparative network calculations. On 208 and 240 v circuits, this would give results somewhat higher than the true values.

Doubling source capacity in the example would increase the fault current to 61 ka. Where a larger source may be provided in the future, it must be re-

*A derivation of this method, with more complete examples of this and other short methods, is scheduled in an early issue.

membered that it may raise fault currents above capacities selected on the basis of the original source. Therefore, allowances should be made for expansion of the source as well as expansion of the load.

Switchgear Assemblies

Typical sizes of basic units and sections are illustrated in Fig. 29, and Table 14 lists breakers by interrupting capacities of standard ratings, along with the continuous current ratings available for each capacity and size of basic unit required.

Overall height of switchgear would probably average between 6 and 8 ft, although superstructures for relays and instruments, and enclosures for outdoor use will increase that figure. Width of sections will vary from slightly less than 2 ft for three and four high units to 4 ft or more for the basic units designed for the largest breakers. The narrower sections are also often arranged so that, for example, a larger unit such as disconnect switch and limiter bus will be mounted in the space normally taken by two small basic units.

Only one auxiliary compartment is shown in Fig. 29, but as many as necessary may be used for metering and relaying or for transition between basic units where bus level varies. High voltage compartments may also be provided in the secondary section when necessary for primary relay circuits.

Table 15 lists the components typical of a basic unit. Table 16 gives the principal load center switching and protective devices which may be included as variations of item 2, Table 15, with items 2 through 12 being modified as necessary.

Common applications for load center air breakers, molded case breakers and fused switches are illustrated in Fig. 30. There are, of course, innumerable variations in circuits and equipment arrangements.

Grounding the system

There is a rather common preference for operating a power system ungrounded because a fault on one line or phase winding will not cause an immediate power outage and the system will continue to operate until the fault can be located at a more convenient time. However, most recommendations call for a grounded neutral system for the following principal reasons:

1. A fault on one phase causes full line to line voltage to appear on the other two phases throughout the system. This is 1.73 times the line to neutral value, increasing the tendency for other faults to ground.

2. Transient overvoltages due to switching are several times greater, not only because of the higher line-to-ground voltage but also due to the arc restriking at the point of original fault during switching operations.

3. Faults on an ungrounded system are difficult to locate and increase cost of operation because each circuit must be opened individually until the defective circuit is isolated. Faults in a grounded system are isolated immediately and automatically.

4. When an ungrounded system is operated with one phase faulted, a fault on another phase will cause more of a prolonged system outage than a fault on a grounded system. It is probable that two machines will be involved and damaged seriously, and at least one of the faults will have to be found before the system can be returned to operation

5. Ground fault current can be limited on a grounded system, restricting damage caused at the point of failure.

6. Operating records seem to indicate less danger for the grounded system. Maximum voltages at equipment are lower, making it safer for operating personnel, and electricians apparently have more respect for a grounded system than for one that is not.

Where to Ground

Recommended practice is to ground the *source* at each voltage level, never the load. Thus the primary system is grounded on the secondary of the main substation transformer or at a generator which is continuously supplying the primary bus. The secondary system should be grounded at each load center transformer secondary. Equipment which is liable to be disconnected, such as motors or the load center transformer primaries should not be used. Even though many load units are used for grounding, the number on the line at any one time cannot be controlled and the impedance of the neutral circuit will vary.

In general, the neutral of a secondary wye connection is preferred. One corner of a delta connection may be used. This will limit high transient voltages caused by an arc restriking at the point of fault during switching, but the ungrounded lines will operate with full line voltage to ground. Therefore, the delta corner ground is seldom used and is usually limited to 240 v circuits.

How to Ground

Many transformer secondaries are wye connected and have a neutral bushing for the purpose. For delta connected secondaries, a grounding transformer is used. This may be a two winding transformer with a wye-delta connection, but a single winding unit designed for the purpose will usually be cheaper. A grounding transformer is designed to carry its rated current for a short time only and its physical size is normally about 1/10 that of standard transformer of equal rating.

The neutral of medium voltage system (2.4 to 15 kv) is usually grounded through a resistor, which is commonly rated for the current it will pass on a line to ground fault at its design voltage. This resistance will reduce ground fault currents, thereby reducing burning both at the point of fault and in switchgear, as well as decreasing mechanical stresses and voltage dips. In general, the ground fault current may be limited to between 5 and 20 per cent of the three phase fault value, but in all cases, it must be adequate to operate all relays or other protective devices.

Reactance grounding is generally preferred only in the larger systems of industrial plants whose supply lines are much exposed to lightning transients.

Utilization systems (600 v and below) usually have solidly grounded neutrals. Resistance of the ground path is adequate to limit the low voltage currents and, in fact, may be too high to insure operation of protective devices. It is advisable to make sure the ground return paths do not have high resistance points.

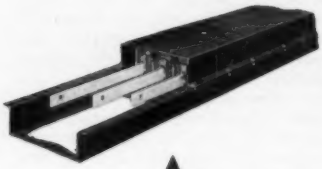
Grounding transformers for low voltage systems should be able to pass at least 25 per cent of the three phase fault currents, or more if this value is not great enough to trip the largest breakers and fuses in the system.

Wye Connected Transformers

When selecting new transformers, the cheapest method of providing a neutral for grounding is to obtain the units with wye wound secondaries and a neutral bushing. The cost is relatively low, and even though it is felt that the extra expense of a completely grounded system is not immediately justified, especially in view of the fact that faults are not so likely to occur on new equipment, the bushing will be available when the system is completed at a later date. Furthermore, use of the transformer in other systems that must be grounded will be possible. For example, a 480 v system with a neutral may be readily adapted for 265 v lighting in present or future circuits.

Examples of units and controls that extend

power centers



Bus duct—Carrying a main feeder circuit, branch circuits are connected near point of use. Accessories include plug-in breakers, switches (shown), fused outlets, capacitors

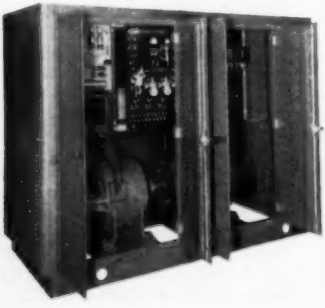
Motor control panels—These panels usually join smaller branch feeders to main feeders in a subdivision of the main load center area, keeping control handy to operations

Lighting centers—As with motor control centers, branch circuit lengths are reduced, switching is convenient to the location. Dry-type transformers often energize the panels

equipment for power factor correction

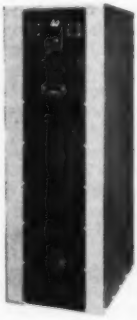
Controls for synchronous motors—Similar in appearance, these controls are often combined in the load center, or form a unit in themselves near the motor location

Capacitor banks—Metal enclosed, these units may also be combined with the substation. The smaller sizes may be located at ends of feeders, increasing their capacity



voltage regulators

In many plants, voltage of load centers, or of entire system, is controlled with load ratio or step type regulators on the transformers. In others, voltage regulation on individual secondary feeders or loads with packaged units (illustrated) is considered adequate. Step-down ratios are available



packaged speed control units

Speed control units are an example of specialized packaged equipment that changes and regulates the characteristics of electrical power delivered to utilization equipment. Included in the variety of types available are rotating, electronic, and combinations of the two (shown in photo at left)

advantages of packaged distribution equipment

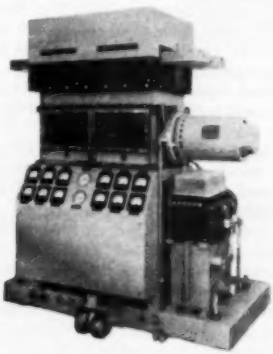
power utilization at primary voltages

High voltage starters—These starters are actually load center units for large motors wound to utilize power at primary distribution voltages. They may be combined with regular load center units, or located as close to the motor as is convenient. Main components are fuses for fault protection and isolation, contactor and relays and other controls as necessary for the application

Individual transformers—Although most loads, including welders and controls, can be designed to operate at primary distribution voltages, safety or other factors may make lower levels preferable. Large resistance welders, with intermittent demands often as great as the average substation, can be supplied directly from the primary system using economical spot transformation

rectifiers

Metallic plate type—Although made in all sizes, they are most commonly used in the smaller units not requiring regulation. They are made for a wide range of voltages

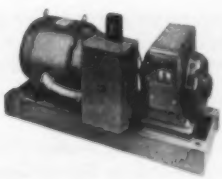


Mechanical type—Efficient at low voltages and capable of very high currents, the rectifier (illustrated) is combined with transformer and controls as a d-c substation

Electronic types—Most efficient at the medium and high voltages, they are available as substation sections or as complete d-c load centers. Output can be regulated

m-g sets and controls

Starters and controls—M-G sets are used in numerous ways to change the characteristics of electrical power. Included are induction heating supplies (illustrated), d-c supplies and m-g sets to absorb peak loads. Controls are packaged, large machines may be near work for lower cable impedance



Smaller, complete units—Smaller sets may be built into a section of the substation switchgear or located at the utilization point. High frequency supplies for power tools (illustrated) is another increasingly common application for power conversion equipment that is now being used on distribution lines

I&P SPECIAL REPORT TO INDUSTRY

Summary and Purpose of Report on

Packaged distribution equipment

Begins on page 75

ELECTRICAL DISTRIBUTION systems involve many factors which cannot be adequately covered in a report of this length. Engineers responsible for supplying the electrical power to operate the plant and its processing equipment are necessarily concerned with all phases, including selection of the system and equipment, installation, application, control, protection, and maintenance. Information is needed, not only on the equipment itself and on the best theoretical methods of application, but also on the many practical details and problems that arise in individual situations. Furthermore, since each method or type of equipment has its own field of application, although they may frequently overlap, discussions giving comparisons and limits of the various features are often welcomed.

INDUSTRY AND POWER will publish a greatly increased number of articles treating generation, distribution and utilization of electric power. They will be selected to present the best engineering information and thinking covering *all* phases as outlined above. In presenting detailed information on a specific phase, however, such articles must, in general, be limited to a bare outline of features of the distribution system pertinent only to the subject. Consequently, it is seldom that an over-all picture of equipment, circuits and applications can be published in one article.

This report, therefore, was prepared as a general survey of modern equipment and the circuits and engineering practices commonly in use and accepted in present day installations. Its specific purpose is to provide a working background and a "springboard" for the more detailed future articles concerned with particular phases and their associated problems.

Future Articles

The report was prepared as a general guide in the selection and application of equipment and circuits. No attempt was made to completely cover all types and designs of equipment; only single examples typical of fairly wide application were chosen for discussion. Similarly, circuits suitable for the majority of applications were included; and recommendations of various authorities were studied and summarized.

Important phases which could not be adequately covered include plant-owned generating capacity and the switchgear and primary substations associated with it, automatic relaying for fault protection and restoration of service, voltage regulation on a plant-wide basis, comparative methods of power factor correction, and utilization feeder circuits and equipment. Articles on these subjects, as well as those in the report, are scheduled.

These articles will be selected to cover all viewpoints necessary in engineering the plant electrical services. Some like "Purchased vs Generated Power" will primarily consider the economic aspect. Others, such as articles on protective relaying, synchronous vs induction motors (March), and a comprehensive engineering report on bus duct will treat selection and application of equipment. Maintenance and troubleshooting will be well covered with articles on subjects such as "Locating Feeder Faults" and "Hazardous Location Wiring" (March). Still another approach will be the plant installation reviews in which the particular problems met in new or rejuvenated installations are discussed along with their solutions. Two such articles scheduled are on installations by the Missouri Portland Cement Co. (March) and by the Western Electric Co. (April).

Authors for the articles will represent the best experience in their respective fields. Many will be engineers representing the equipment manufacturers who, with complete design information and the results of many applications on hand, are best qualified to give recommendations for maximum results. Approximately an equal number will be engineers who have met and solved the problems in their own plants where many other factors must sometimes modify the best engineering plans. Still other authors will be consulting engineers familiar with all equipment and applications.

ACKNOWLEDGMENTS

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UTILIZING WASTE ATOMIC PILE HEAT

Reports indicate first heating system utilizing waste heat from experimental atom pile is now in operation. Estimates show 1000 ton of coal will be saved yearly when installation is completed. Heat exchanger has closed circuit to eliminate danger of radio-activity being transferred to wash water

DEVELOPMENT in Britain of an atomic central-heating plant—the first of its kind in the world—holds out hope that in the atomic power field, science is emerging from the phase of development and entering that of application. This new plant is quite small and presents no very startling features of design, but it undoubtedly represents an important milestone in the industrial application of atomic energy.

This plant supplies heat to a building containing 80 offices at Britain's Atomic Energy Research Establishment at Harwell in Southern England. Heat is drawn from the large experimental pile. Plans have been made to extend the system eventually to two or three other buildings.

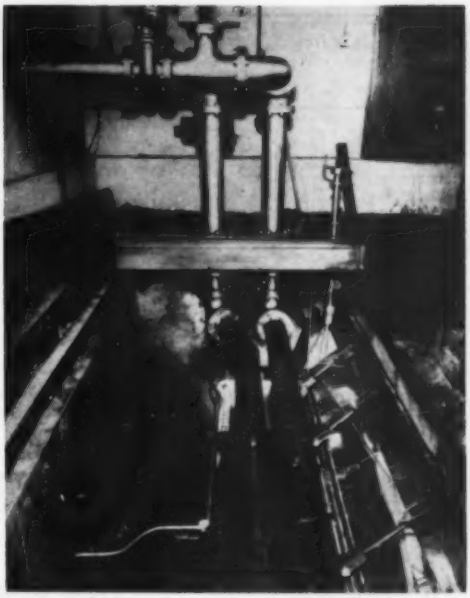
Constant flow of hot water is obtained day and night by means of a heat exchanger, an eight ton metal structure, connected to the pile's air-cooling system. This water is circulated by a pump in a closed system. By means of a second exchanger, heat is transferred to the main system supplying radiators and hot water taps. This indirect method is employed to eliminate the risk of dangerous radioactivity being transferred from the pile, and water supplied is safe for every purpose. Heat output is about one million Btu and provides 130 F water for heating and sanitary facilities.

Britain's Ministry of Supply states that coal consumption will be cut by at least 1000 ton a year when the remaining buildings are added to the present system. Savings are estimated at $7420 a year compared with an installation cost of $42,000 for the entire plan. Extensions contemplated will not require another heat exchanger but merely additional piping and radiators.

Capital expenditure will be repaid by elimination of fuel costs within a comparatively few years. Modifications now being made in the pile will supply considerably hotter water in 1952 at the same cost.

So far as they go, these figures are encouraging. They do not, of course, include the initial cost of the pile itself, so unit costs cannot be calculated to compare with conventional fuels. This is, however, a utilization of waste heat. Real purpose of the present pile is research and evaluation of this service is impossible.

In a recent broadcast the director of the Atomic Energy Research Establishment disclosed future plans for the industrial utilization of atomic power. An atomic pile is now being designed exclusively for the production of power. Studies of this pile will eventually furnish information of relative cost compared with that of power derived from coal, water-power and other conventional sources. At least another ten years of experiment and experience will be necessary before application on any great scale is feasible.



Operation of an atomic central heating plant at Harwell, England was started during Nov. 1951. System supplies heat and sanitary facilities to building containing 80 offices

Atomic piles may not displace existing sources of power but will usefully supplement present resources. Estimates indicate that power production efficiency of atomic piles can be increased as much as a hundredfold if designed specifically for this purpose.

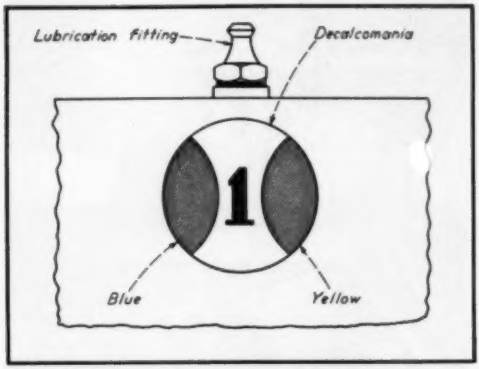
There is much evidence that a country's standard of life can be quite closely measured in terms of the amount of power produced per head of population. On this basis power indexes have been calculated for various countries. For Britain and most European countries it is about 2000; for the United States, about 3000, and for India about 100. With normal sources of power intensively exploited at present, a completely new source of power on a large scale is of exceptional interest.

The Cover—Stone Age

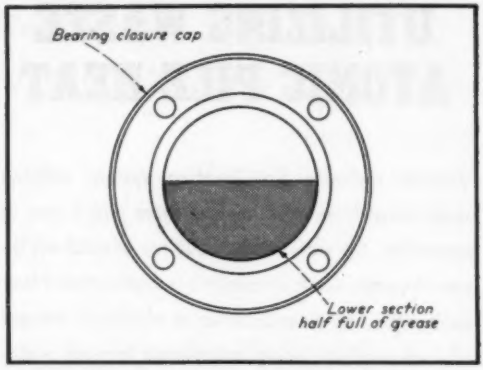
• This month's cover entitled 'Stone Age' indicates how Caterpillar diesel power plays a major and leading role in America's yearly production of 150,000,000 tons of limestone. The cover illustrates the Arthur R. Alvis limestone plant near Butler, Mo. that produces 200 ton of limestone per hr.

At the Alvis stationary crushing plant a No. 4 Universal pulverizer is powered by a Caterpillar D375 diesel engine developing 335 hp. A 20 in. by 36 in. Universal jaw crusher is powered by a Caterpillar D8800 diesel engine developing 102 hp. A D8800 electric set generates power for the motors.

Limestone produced at this plant goes principally to the farmers in the surrounding area while daily output of 1000 ton of road rock is distributed to county townships and contractors.



Positive lubricant identification is provided by matched decals on each bearing, storage container and grease gun



When no lubrication fitting is furnished, the closure cap is half filled with grease prior to mounting on bearing

BEARINGS . . . . LUBRICATION WITH GREASE

Proper grease lubrication requires precise knowledge of operating conditions and intelligent application of instructions furnished by bearing manufacturers. Service frequency and lubricant quality depend upon temperature, speed, load, and operating cycle involved

THOMAS TRAIL

MODERN MACHINERY becomes more involved each year, and with this continuous increase in complexity comes a multiplication of bearing types. Many of these bearing types are intricate, requiring exacting lubrication methods and precise selection of lubricants. For this reason the old-fashioned, haphazard methods of greasing bearings should be replaced with a program of periodic lubrication, inspection and maintenance. Too much depends on the integration of machines in maintaining high-speed production to permit slipshod lubrication.

To insure adequate lubrication of bearings, lubrication instructions issued by the machinery manufacturer should be followed. Operating conditions vary in different plants, and carefully checking operations and conditions is necessary in order to determine the exact procedures to follow for each specific application. Notes should be taken of conditions at each inspection or servicing. Based on the conditions found, the lubrication and bearing care program can be gradually worked out to provide maximum benefits and minimum expense for the particular plant involved.

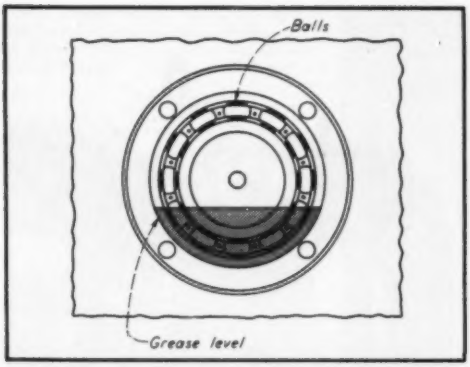
Lubrication of modern machinery bearings should be entrusted only to personnel that have a sufficient degree of mechanical understanding to know how and why bearings should be properly lubricated. Furthermore, the job will be correctly handled if a suitable program of lubrication simplification be prepared and thoroughly established. This can take one of several forms. For example, one lubricant firm has developed a system whereby each lubrication point is marked with a colored decalcomania bearing a number. This number identifies the proper lubricant to be employed, since a duplicate decal is placed on the storage container of lubricant and also on the grease gun used for applying the particular lubricant.

These decals come in two color combinations, yellow and blue or yellow and red. If desired, one color combination may be employed to distinguish points to be lubricated by lubrication personnel. Another color combination may indicate locations to be lubricated by the machine operator or the points that require lubrication every shift.

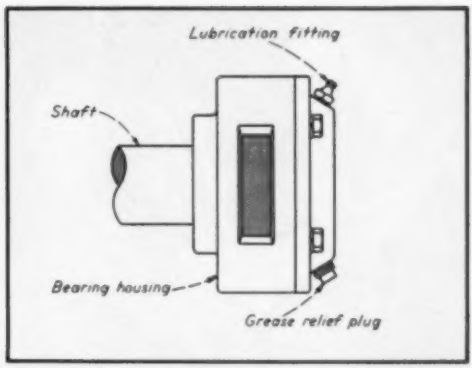
Record cards will furnish the storekeeper with information to enable him to enter the brand name and code number of each type of lubricant used in the plant. Lubricants can thus be ordered by name and dispensing containers marked with correct decals.

Next procedure to establish is frequency of lubricant application. In plain bearings, of the sleeve or sleeveless type, grease may be required daily or at longer intervals, such as bearings that move slowly or seldom. However, to determine the necessary frequency of lubrication, or the quantity to be applied, the machine surfaces outside the bearings should be carefully wiped clean of all lubricant before new lubricant is introduced. This will show the amount of lubricant that escapes between applications and will indicate the quantity required to insure complete bearing surface coverage. Condition of the escaped lubricant can be utilized as a guide to determine the proper type and grade to be employed. Evidence of melting and thinning will usually indicate the necessity for a grease having a higher heat resistance. Caking or hardening, on the other hand, will generally show the need for a softer grade of lubricant.

Lubrication requirements of ordinary anti-friction type bearings require a longer period to determine. It is therefore advisable to open and inspect the enclosures of such bearings at monthly intervals until these requirements have been determined. If the grease condition shows excessive deterioration has taken place, and the bearing enclosure is not more than ½ filled with lubricant, the lubricant used is probably unsuitable for the require-



Housing 1/3 full contains ample grease for good operation. Overfilling may cause excessive pressure or temperature



Relief plugs are removed while adding grease and not replaced until 20 min after bearing is returned to service

ments. The same is likely if the grease has left hard soap deposits on the load-carrying parts of the bearing, or if the grease has become emulsified. If the quantity of lubricant remaining on the bearing parts and in the bearing enclosure is abnormally small, the logical indication is that lubrication should be more frequent.

In selecting lubricating greases for various applications the operational requirements of the bearing should be carefully considered. Grease is composed of mineral lubricating oil and soap, the quantity of soap usually being relatively small in comparison to the oil. For good grade grease a top quality oil is required. The grade of oil depends on the bearing service requirements. For high temperature, low speed applications, a heavy viscous base oil is employed. For high speeds or low temperatures, a light bodied oil is used.

Greases that have a calcium soap base are generally employed in compression grease cups and pressure fittings on plain bearings, as long as operating speeds do not exceed 2000 rpm or when operating temperatures are below 175 F. Higher speeds and temperatures tend to separate the mineral oil from the soap base. However, these greases repel water.

Sodium soap base greases are applicable for lubricating ball and roller bearings. They are suitable for high speed and high temperature applications but are not adaptable when excessive quantities of water are present to cause detrimental emulsification. These greases may also be employed for lubrication of plain bearings operating at temperatures in excess of 175 F. Some sodium soap greases are "milled" during manufacture to shorten the natural grease fibre and produce a smoother texture.

Calcium soap greases are unsuitable for use in anti-friction bearings subject to high operating temperatures. Moisture contained in the grease can cause complete separation of the soap and oil. This leaves a hard deposit on the bearing load-carrying members.

Greases that contain both calcium and sodium soap bases are highly resistant to deterioration and breakdown and are suitable for bearings that require infrequent lubrication.

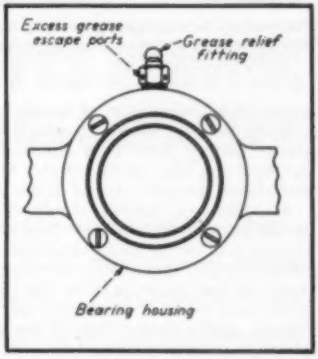
Generally, a grease of medium consistency, such as No. 2 or 3, will serve well in anti-friction bearings operating under average conditions. The lubricant should readily cover the entire surfaces but should not pack in the housing or raceways.

However, a heavier bodied grease might be necessary under high temperature conditions to withstand the thinning effect. Greases containing extreme pressure additives may be required where bearings operate under heavy loads.

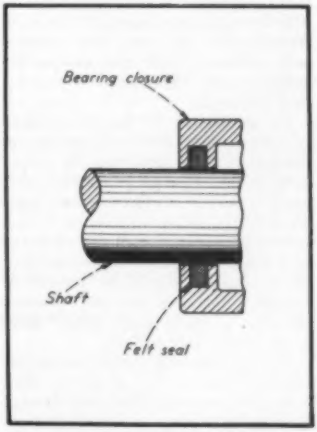
Silicone greases, while more expensive than petroleum grease, possess certain advantages that make them superior for anti-friction bearing lubrication, especially under conditions of extreme low or high temperatures. One type performs satisfactorily between minus 100 F and plus 300 F and at speeds as high as 70,000 rpm.

Good anti-friction bearing grease should be smooth in texture, channel readily, produce minimum fluid friction losses, resist leakage past closures and possess a low oxidation rate. Greases containing fillers of any solid type, such as graphite, talc, rosin or pumice, should never be used in an anti-friction bearing.

Chief duties of an anti-friction bearing lubricant are to provide a lubricating film between the balls or rollers and their separators, to carry away heat



Special fittings equipped with relief openings allow grease to escape before pressure exceeds a predetermined value



Shaft seals must be inspected periodically and replaced when necessary to insure satisfactory operating service

Illustration shows proper procedure for removing lubricant shield from anti-friction bearing mounted on motor shaft

Sump pipe is inspected frequently while adding lubricant until grease appears. Pipe is then cleaned and replaced

produced by deformation of the load-carrying members and the separator, to protect bearing parts from rust and corrosion and help prevent entrance of dirt, water, particles or acid fumes.

Lubricating grease should be handled and introduced into bearing closures with care to insure cleanliness. Manufacturers clean new bearings, wrap and package them in air-filtered rooms and lubricate them with only highest quality grease. Yet all these precautions can be destroyed in a few seconds if dirt or grit is permitted to enter the bearing with the grease. The rotating members are in metal to metal contact, often under extreme pressure. Dirt consists of tiny diamond-hard particles and when mixed with grease an effective lapping compound is formed. Rotating bearing parts thus affected will gradually wear and destroy the original close fit along with accuracy and efficiency.

Grease should be kept in covered containers, in a dust and grit-free atmosphere. The first step in proper lubrication is to wipe all dust and dirt from container surfaces, grease guns and bearing filling connections. Covers from containers should be removed only long enough to transfer lubricant. Wood paddles should be avoided in handling grease as they may produce splinters. A putty knife would serve as an ideal grease paddle.

Bearing housings should be approximately ¼ to ½ full of grease. This is important as overfilling may damage bearing by causing excessive pressure at operating temperature, and shaft seals may be destroyed. Excess grease will also create churning and overheating and may retard the bearing. This may cause flat spots to form on the rotating members and raceway tracks to roughen.

Some bearings are pre-packed with grease and sealed at the factory. In most instances no further lubrication is required through their useful life. Others will operate for periods of three years or more before disassembly, cleaning and re-packing with fresh lubricant are necessary. Various factors of bearing design and operation determine service periods, which may vary considerably. However, bearings operating under normal conditions should be inspected at least once a year. At each inspection the housing should be opened, carefully cleaned, and the condition of the bearing and grease noted. Hardening of the grease or the presence of an offensive odor indicates a grease change. Replacing grease is less costly than a shutdown to install a bearing.

Between inspections, anti-friction bearings should receive additions of grease at periods determined by operating conditions. Where bearing housings are provided with relief plugs, the plug should be removed before introducing lubricant. After old grease has been expelled and fresh grease appears at the relief opening the greasing job is complete. The bearing should operate for at least 20 min. before replacing relief plug.

If a bearing housing is provided with an overflow sump, remove the plug and clean out any accumulated grease. Then follow same procedure as for bearing housings having relief plugs. Sumps should be emptied before replacing plug so excess grease may escape during this operation.

Some bearings are provided with excess pressure relief fittings that permit grease to escape when the pressure reaches a predetermined setting. Escaping grease is the signal to stop adding lubricant. When bearings are not provided with relief plugs or sumps, the housing should be opened and as much old grease removed as possible before repacking.

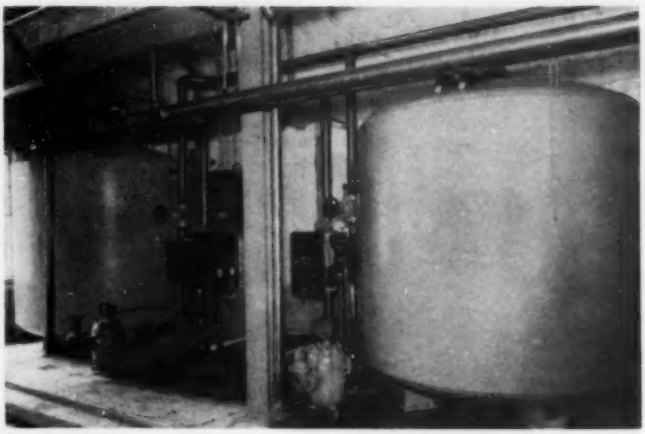
When the grease has become badly oxidized, an emulsifying solution of cutting compound and hot water should be run through the housing, while rotating the bearing. This solution must be drained, and the bearing and housing thoroughly flushed with hot, light oil (rotating the bearing during these procedures) and again drained before lubricant is added.

Hydro-carbon solvents should not be employed for cleaning grease-lubricated bearings, due to the possibility of leaving non-soluble soap residues after the oil content has been removed by the solvent. Shaft seals should be checked for satisfactory condition before closing housing and replaced.

Plain bearings generally do not require cleaning, since normal escape of grease prevents entrance of contaminant and only satisfactory lubricant remains within the bearing.

Lubrication personnel should be trained to detect operating difficulties such as excessive heat, unusual noise or lubricant leakage and be able to provide immediate corrective attention.

Careful training of lubricating personnel by studying bearing, machinery and lubricant manufacturers' instructive material is essential.



Control panel shown on column between tanks provides pushbutton starting of the regenerative cycle for this semi-automatic zeolite water softening unit

MODERN ZEOLITES PROVIDE HIGHER EXCHANGE CAPACITY

Recent zeolite developments have greatly increased capacity of base exchange water softening systems. Uniform grain structure permits higher flow rates and longer operating cycles. Application of automatic controls results in improved efficiency and lower maintenance

S. F. ALLING, *Vice President*
Hungerford & Terry, Inc.

GREAT ADVANCES have been made during the last decade in the zeolite softening field. This article will point out some factors contributing to this progress and their effect on industrial base exchange type water softening systems.

Before World War II, most sodium cycle zeolites required about 0.5 lb of salt (sodium chloride) for regeneration before 1000 gr of hardness could be removed from a water being softened. Today both natural greensand and synthetic resin type zeolites are available, which require, when softening most waters, as little as 0.3 lb of salt—representing a direct salt saving of 40 per cent.

Some users of zeolite softening equipment fail to take this saving seriously or even time to calculate what it means to them in dollars and cents. Recently an owner of two 7 ft dia softeners, in central Pennsylvania treating 10 gr hardness water, was surprised to find that by installing a higher efficiency zeolite nearly $2000 was saved annually on salt. This was enough to pay for the change-over in two years. In addition, there were increased capacity and flow rate, savings in rinse and wash water, lower salt handling costs, smaller salt storage space and reduced operating expenses.

At another location where a small boiler plant was being supplied by water from a 3 ft dia softener, a saving of 40 lb of salt per day was translated into an annual reduction of $146 in salt costs. This represents a yearly return of 15 per cent on the capital investment involved.

Exchange Capacity

Present day zeolites have increased greatly in base exchange capacity. Formerly about the only greensand zeolite available was the standard 2800 gr variety, while now capacities of 3800 and 5000 gr per cu ft are common. Newer synthetic resins can, under proper conditions of operation, remove in excess of 25,000 gr of hardness to the cubic foot of material.

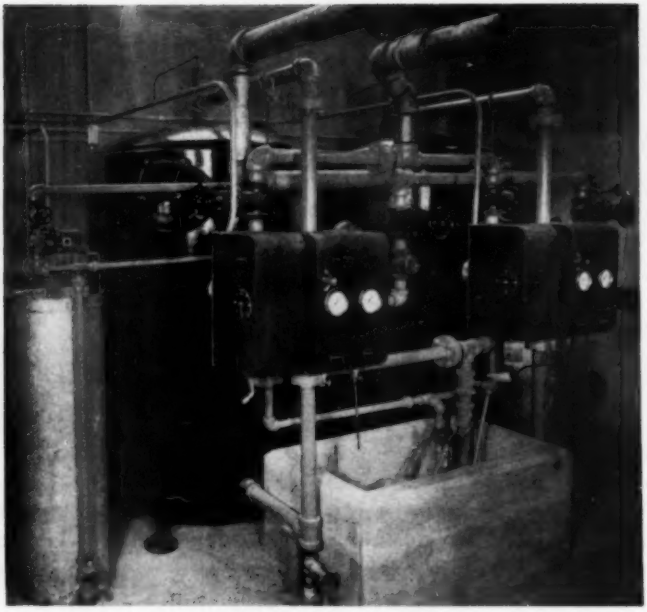
This means softening equipment operates longer between regenerations, thus saving wash water and labor because of fewer shutdown periods. In many cases smaller size equipment can be installed requiring less space and costing less to purchase and maintain.

Zeolites have been further improved with respect to grain size and uniformity. Greensand zeolites are now being offered with an effective size of 0.34 mm instead of 0.28 mm and have more uniform grain structure. This means greater flow rate in gallons per minute through the softening equipment, less pressure loss and better all-around operating efficiency. Previously fine grained zeolite caused a high degree of bed packing, which reduced the water pressure. Bead type synthetic resins are now available that are being satisfactorily operated at over double previous conventional flow rates.

Ten years ago, relatively few zeolite water softeners were operated automatically, almost all being manually controlled. Each unit required attention for nearly an hour each time it was backwashed and regenerated, and the operating efficiency of the

TABLE 1—SOME HIGH EFFICIENCY ZEOLITES

	Capacity in gr per cu ft	Salt in lb per cu ft	Salt in lb per kg hardness removed
Greensand	4000	1.4	0.35
Invercarb-SR	8000	2.4	0.30
Styrene resin	20,000	6.0	0.30



Automatic inversand system utilizes two 3 ft dia tanks. The design capacity can be maintained by one unit while the other is undergoing regeneration

Electrical timer is employed to set the multiport valve for position determined by operating cycle

equipment depended largely on the care exercised in manipulating the operating valves. Often backwashing time increased 100 per cent thereby wasting considerable water and frequently an extra inch or two of brine. Sometimes brine circulation through the zeolite bed was too rapid, sacrificing salt and equipment capacity.

Automatic Controls

Today an increasingly large percentage of softeners are either fully automatic or semi-automatic in their operation. In the case of fully automatic operation, a water meter or other means starts the operating cycle after a definite amount of water has passed through the softener. The multiport valve is positioned by an electric motor for backwashing, brine injection, brine rinsing and returning to service. This operation is controlled in accordance with predetermined time intervals established by electric timer.

In the semi-automatic system manual starting is necessary. An alarm on the water meter rings notifying the operator that the correct amount of water has passed through the softener and the unit requires attention. A button is pushed on the control panel to start the regenerative cycle and the balance of the operation is automatic.

Semi-automatic equipment costs slightly less than fully automatic and is sometimes preferred. It requires an overseer who periodically observes the operation and can run a hardness test on the raw water. If necessary, adjustments can be made in the control setting to compensate for any increases or decreases in raw water hardness.

Advantages of automatic softening are: (1) savings in labor and (2) efficient operation. Savings in labor frequently can pay for the additional cost of automatic controls in from 1 to 3 yr.

Regeneration

Water softeners perform better and have longer life when properly backwashed and regenerated. Overwashing wastes water and exhausts the zeolite of absorption capacity. Automatic operation has a definite backwash time cycle, which controls water flow and maintains exchange rate.

When brine is injected manually an excessive amount of brine is often provided for regeneration. This excess brine, in most cases, is of no benefit to the equipment and, therefore, represents a total loss. Automatic injection results in correct amount of brine for capacity restoration.

Brine contact time with the bed, also referred to as *brine rinsing*, is important. If the period is too short the zeolite would not be fully regenerated, and the softener cannot deliver full gallonage of soft water during the softening run. When the brine rinsing is too long, operating costs are increased considerably.

With automatic brine rinsing the brine stays in contact with the zeolite the correct length of time for its complete regeneration and insures a maximum number of gallons of soft water from the unit.

One recent project required a continuous supply of 350 gpm of soft water. Two 8 ft dia softeners were contemplated, interconnected and valved so that either unit would handle the entire flow rate while the other was shut down for regeneration. Each unit was to be manually regenerated every 8 hr. Approximate cost of this system was $14,000.

Designing automatic equipment to operate on a 4-hr cycle provided similar service for an investment of $13,200. In addition, there was a labor saving of nearly $1500 annually.

Controls for small units are expensive when compared to the total installation cost. In medium size systems, the additional cost of semi or fully automatic controls is relatively small. Larger automatic softeners are often less costly than manual equipment designed for equivalent capacity.

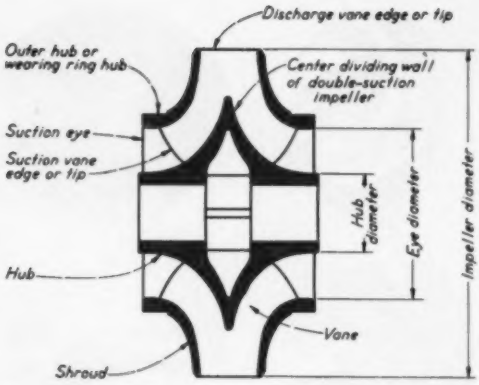


Fig. 1—Double-suction impeller is in effect two single-suction impellers placed back-to-back in a single casing

CENTRIFUGAL PUMPS

Part 4-Types and Applications of Impellers

Pump design, manufacturing problems and service conditions all have a bearing on selection of impellers. Proper design and selection results in peak pump performance and low maintenance

IGOR J. KARASSIK and ROY CARTER, *Application Engineers, Worthington Pump & Machinery Corp.*

THE IMPELLER is the heart of the centrifugal pump. It rotates the mass of the liquid and the peripheral speed of its vane tips determines the head produced or the working pressure of the pump. On the basis of the water supply to the impeller inlet, impellers are subdivided into (a) single-suction impellers and (b) double-suction impellers.

In a single-suction impeller, the liquid enters the suction eye on one side only, while a double-suction impeller is, in effect, two single-suction impellers arranged back-to-back in a single casing so that the liquid pumped enters the impeller simultaneously from both sides. Normally, with double-suction impellers, Fig. 1, the two suction passage ways of the casing are connected to a common suction passage and a single-suction nozzle.

Single and Double Impellers

In the general service, single-stage axially split casing centrifugal pump, a double-suction impeller is favored because it possesses two advantages: First, it is theoretically in axial hydraulic balance eliminating the necessity of an oversized thrust bearing which would always be under full load, and second, the greater suction area available in a double-suction impeller permits the pump to operate with less net absolute suction head for a given capacity than is possible with a single-suction impeller.

In small capacity units, the single-suction impeller is more practical than the double-suction type for manufacturing reasons because the waterways are not divided into two very narrow passages.

In certain applications, a single-suction impeller is preferred for structural reasons. End suction pumps with single-suction overhung impellers present certain advantages which cannot be obtained with a double-suction impeller; therefore, all radially split casing pumps generally embody single-suction impellers. Because an overhung impeller does not require the extension of a shaft into the impeller suction eye, single-suction impellers are preferred for pumps handling suspended matters, such as sewage. In multi-stage pumps, the use of double-suction impellers carries with it certain shortcomings which have led to an almost universal use of single-suction impellers for such multi-stage units.

The shape or the form of the vanes divides impellers into several distinct types: Straight vane (Figs. 2, 3, and 4), francis vane (Figs. 5 and 6), mixed flow (Fig. 7) and propeller or axial-flow impellers (Fig. 8).

In a straight-vane impeller, the surfaces of the vanes are generated by straight lines parallel to the axis of rotation. Vanes of this type of impeller are also called single curvature vanes.

In a francis-vane impeller, the vane surfaces have a double curvature. This type is also often called the francis screw-vane or screw-vane impeller.

An impeller design in which there is both a radial and axial component of flow is called a mixed-flow impeller. It is generally restricted to single-suction designs having a specific speed above 4200. Lower specific speed types are called francis-vane types. Mixed-flow impellers having a very small radial flow component are generally classified as propellers.

A true propeller or axial-flow impeller is one having a flow solely in the direction of the axis of rotation; in other words, strictly axial.

Design Variations

The relation of the impeller profiles to the specific speed will be discussed in detail in a forthcoming article of this series. Any classification of impellers according to their vane shape is arbitrary inasmuch as there is much overlapping in the types of impellers used in the different types of pumps. For instance, lower specific speed single-suction and double-suction pumps may have impellers with vanes extending across the suction eye, giving a mixed flow at the impeller entrance to meet the requirement of low pickup losses at high rotative speeds; however, the discharge portion of the impeller follows the straight vane principle. Higher specific speed pumps operating against low heads have impellers with double curvature vanes extended over the full vane development; therefore, they have full francis-type impellers. The mixed-flow impeller which is usually a single-suction type is essentially one-half of a double-suction extreme francis-vane impeller.

In addition, there are a great number of impellers specifically designed for a particular duty. For instance, for handling liquids containing rags,

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** This article will be included in a book on centrifugal pumps now being prepared by the authors; hence, all rights to republication are reserved by them.*

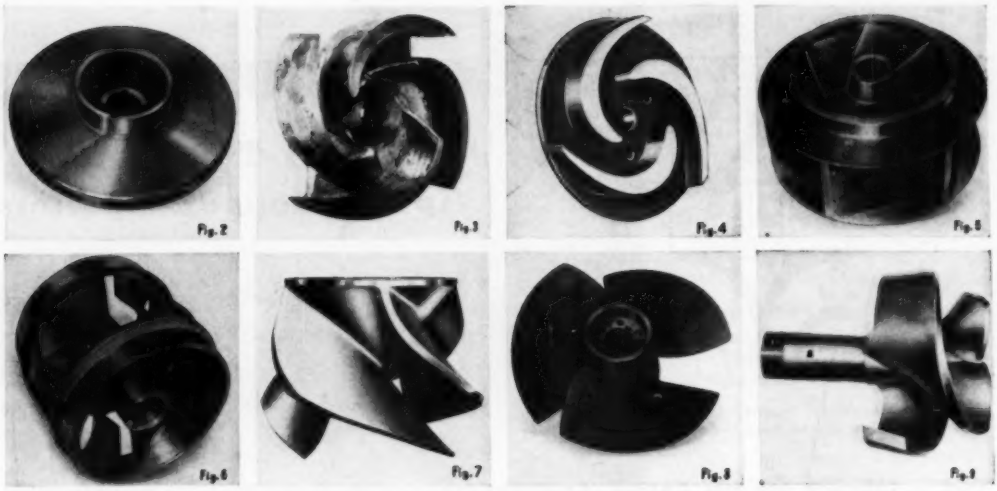


Fig. 2 Fig. 3 Fig. 4 Fig. 5

Fig. 6 Fig. 7 Fig. 8 Fig. 9

Shape of impellers divides them into several distinct types: Figs. 2, 3 and 4 - straight vane; Figs. 5 and 6 - francis vane; Fig. 7 - mixed flow; Fig. 8 - propeller or axial flow. Special impeller designs are often employed for specific jobs. For example, the fully open non-clogging type shown in Fig. 9 is used extensively for paper pulp and similar materials

stringy materials and solids like sewage, the conventional impeller design with sharp vane edges and restricted areas is not suitable as it will become clogged. Special designs with blunt edges and large waterways have been developed and are known as non-clogging impellers. For pumps up to 12 to 16 in. size, these impellers are made with only two vanes. With larger pump sizes, three or four vanes are generally used.

Another example of special impeller application is illustrated in Fig. 9 which shows a design used for paper pulp pumps. It is a fully open, non-clogging impeller with combined screw and radial streamlined vanes. The screw conveyer end projects far into the suction nozzle. This design permits handling paper pulp stock of high consistency.

Construction Details

Impellers are also classified as to their mechanical construction, such as a completely open impeller, a semi-open impeller and a closed impeller.

Strictly speaking an open impeller, Fig. 3, consists of vanes only, attached to a central hub for mounting on the shaft without any form of a side wall or shroud. With long vanes, this is structurally weak and the vanes have to be strengthened by ribs or a partial shroud. Generally, open impellers are used for small inexpensive pumps or for pumps handling abrasive liquids in which the impeller rotates between the stuffing box head and the suction head. Because of the clearance between the blades or vanes of the impeller and the side walls, there is a certain amount of water slippage, similar to the slip in a reciprocating pump. This slippage increases as wear increases the clearance between the impeller and the stationary side plate. To restore the original efficiency, it is necessary to replace both the impeller and the side plate, a much larger expense than involved for closed impeller pumps where simple rings form the leakage joint.

The semi-open impeller, Fig. 4, has a shroud, or an impeller backwall. This shroud may or may not have pump-out vanes, which are vanes located at the back of the impeller shroud to reduce pressure at the back hub of the impeller. Should the pump handle suspended foreign matter, these pump-out vanes prevent foreign matter from lodging back of the impeller and interfering with the proper operation of the pump and the stuffing box.

The closed impeller, Figs. 2, 5 and 6, which is almost universally used in centrifugal pumps handling clear liquids, has shrouds or enclosing side walls, thus forming totally enclosed waterways in the impeller from the suction eye to the periphery. While this prevents the slippage of water that occurs between an open or semi-open impeller and its side plates, a running joint must be provided between the impeller and the casing to separate the discharge and suction chambers of the pump. This running joint is generally formed by a relatively short cylindrical surface on the impeller shroud rotating within a slightly larger stationary cylindrical surface. By making one or both surfaces renewable, the leakage joint can be renewed when wear causes the leakage to become excessive.

If the pump shaft terminates at the impeller so the impeller is supported by bearings on one side only, the impeller is called an overhung impeller. This type of construction is most advantageously used for end-suction pumps with single-suction impellers.

The inlet of an impeller just before the section at which the vanes start is called the suction eye. In a closed-impeller pump the suction eye diameter is taken as the smallest inside diameter of the shroud. In determining the area of the suction eye, the area occupied by the impeller hub shaft is deducted.

By definition, a hub is the central part, usually cylindrical, of a wheel. In the case of a centrifugal pump impeller it should be applied to one part of the impeller only; that is, the central part which is generally bored out to receive the pump shaft. The expression, however, is also frequently used for the part of the impeller which rotates within the casing fit or within the casing wearing ring, in which case reference is made to the "outer impeller hub" or to the "wearing ring hub of the shroud".

Details on wearing ring hubs and casing wearing rings will be presented in the next article of the series.

NEW LOCK NO. 2, MONONGAHELA RIVER. First ship through on June 1, 1951 was U.S. Steel's "Homestead." A special feature of the lock is an emergency dam, at the upstream end, which can be raised or lowered as needed.

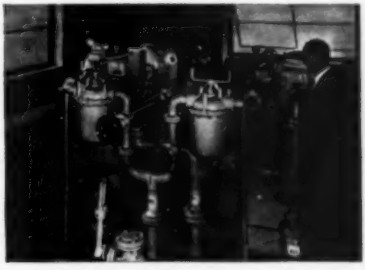
ENGINEERS PICK SUN HYDRAULIC OIL FOR NEW LOCK ON MONONGAHELA

Last year the Monongahela, busy river that flows past Pittsburgh's Golden Triangle, carried 2,000,000 more tons of shipping than the Panama Canal. This year its tonnage promises to be higher still, for on June 1 the U.S. Army Corps of Engineers put in operation their new Lock No. 2, near Braddock.

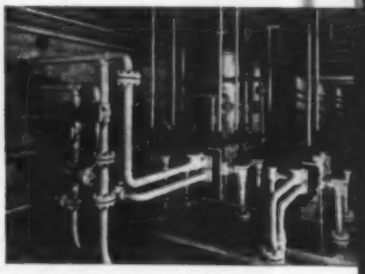
The entire mechanism of this lock... gates, butterfly valves, and capstans... operates hydraulically, and a Sun Hydraulic Oil was chosen as the medium. Why? Because this vital job required an oil that would prevent corrosion and rust; that would retain its original specifications for the life of the equipment; and that would flow freely at low temperatures, yet not thin out at high. The engineers in charge chose a Sun Hydraulic Oil over all other oils because they felt it could be best counted on to keep the lock in operation and river traffic moving.

For complete information on Sun Hydraulic Oils and recommendations as to their use in your operations, write for booklet IP-2.

HYDRAULIC CAPSTANS, operated by Sun Hydraulic Oil, are used when tows, too long for the locks, have to be broken up into units and pulled through mechanically.



SYSTEM'S HEART, operating the lock mechanisms, is a pair of Oilgear hydraulic pumps. They supply 2,800 gallons of Sun Hydraulic Oil at pressures up to 1,100 psi.



UNDERGROUND SYSTEM of pipe lines supplies all hydraulic devices. It is designed so that it will continue to function even though the chamber is completely flooded.

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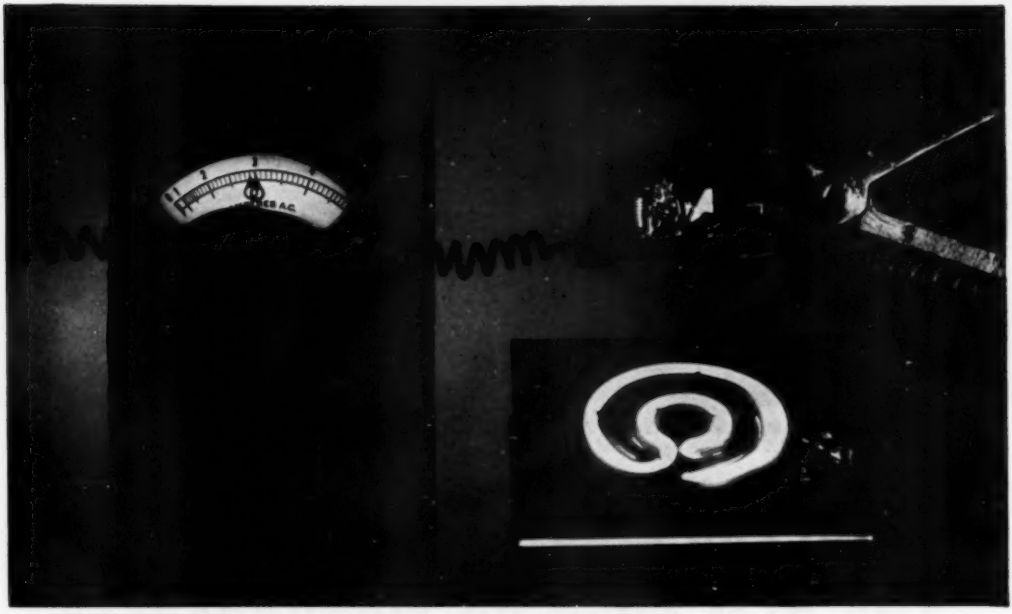
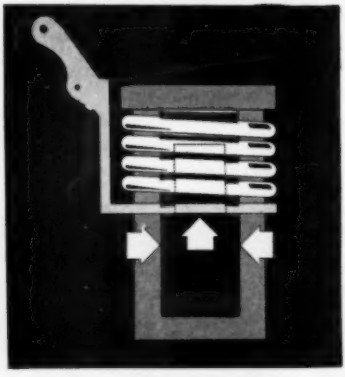


Laboratory demonstration shows 30 amperes continuously flowing through 30 ampere Heinemann Circuit Breaker held over hot plate.

the one circuit breaker principle ...THAT IGNORES HEAT!



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One magnetic coil is the entire actuation of HEINEMANN Circuit Breakers. Thermal warp elements are eliminated. On short circuits, the coil instantly trips the breaker. On small overloads, a time delay is introduced while the movable core is drawn toward the pole piece, increasing the magnetic flux. Moreover, the time delay is proportioned to the overload . . . being shorter for large overloads . . . and longer for small ones.

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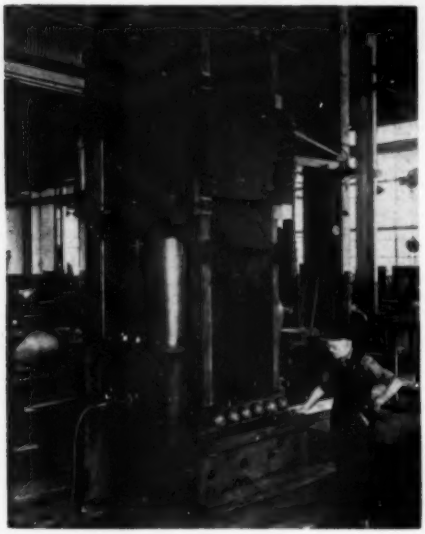
Types and applications of materials that help to solve problems involving corrosion, abrasion, heat and pressure



USES OF DUCTILE IRON ARE INCREASING

Higher physical properties and better machinability, as well as better resistance to abrasion, impact and shock, give it many advantages over cast-iron and cast carbon steel. Easily cast to shape and machined, the cost of manufactured parts can be held to a minimum

For parts of heavy equipment, such as this hydraulic press, ductile iron has proved to be economical and serviceable

HIGHER mechanical properties and lower machining costs of ductile iron continue to expand its use according to reports from foundries licensed to produce the material in this country and in Canada. It is becoming a frequent choice where malleable cast-iron and cast-steel have been used in the past.

Ductile iron has been found to have a tensile strength higher than that of mild carbon steel and a cast finish equal to that of cast-iron. In the as-cast conditions, it machines much more easily than malleable or gray iron of equal Brinell hardness and, in the annealed condition its machinability is still further improved. One foundry reports that in an annealed condition castings can be machined at a saving of 20 to 25 per cent over those made of gray iron.

Mechanical properties of ductile iron as-cast and in the annealed condition are compared with those of malleable iron and cast-steel in the accompanying Table.

When it is possible to produce a cast-iron part with a tensile strength of more than 60,000 psi where previously it was necessary to be content with a tensile strength of 25,000 to 50,000 psi, it means a revolution in industry. Even without the benefit of special design, ductile iron has proved itself. But when redesign becomes practical, limits on its possibilities are further lifted.

A leading Canadian foundry has had great success with this material in the manufacture of rolls for printing presses and other machinery, which rolls require smooth finish and perfect balance. Made in alloy iron, some of these rolls needed reinforcing ribs inside, and balance presented a problem. When made of ductile iron, the ribs were not necessary. A better surface finish was obtained, wear on the rolls was more even and balance was easily maintained.

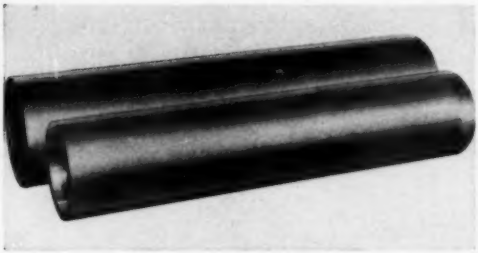
The automobile industry has utilized this material for the manufacture of large dies. Car manufacturers previously were compelled to choose between cast-iron and cast-steel for this purpose, although neither entirely met all needs. Dies made from this relatively new material can be cast to shape so accurately they can afterwards be ground with relative ease to final specifications, whereas expensive contour machining is required to shape cast-steel dies. It is reported that the ductile iron dies have proved harder and longer wearing than most materials.

Another typical illustration of the advantages of this material is reported by a foundry producing digger teeth for sand slingers. Made of mild or machinery steel and subject to punishing abrasion, these teeth lasted only three days. Made of the new type cast-

Data and illustrations for this article were made available through the courtesy of the International Nickel Co., Inc.

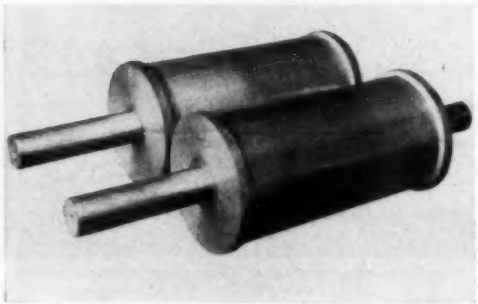
COMPARATIVE MECHANICAL PROPERTIES OF DUCTILE IRON

Material	Tensile strength, psi	Yield strength, psi	Elongation, per cent	Brinell hardness
Malleable iron	53,000 to 60,000	35,000 to 40,000	18 to 25	110 to 135
Cast carbon steel	60,000 to 80,000	30,000 to 40,000	18 to 28	125 to 165
Ductile iron, as cast	80,000 to 115,000	60,000 to 75,000	1 to 5	225 to 300
Ductile iron, annealed	60,000 to 80,000	45,000 to 60,000	15 to 20	140 to 180

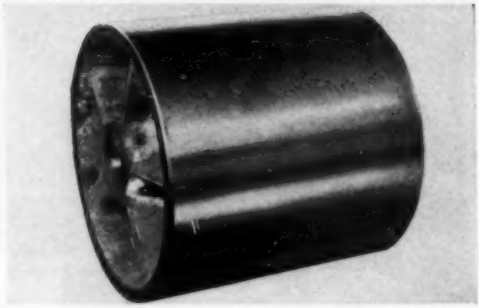


Machinery rolls have high strength and perfect balance. The latter is difficult to obtain even with alloy iron

Better resistance to abrasion and impact is reported for this train of rollers used in modern packaging machines



Another set of packaging machine rolls which is reported to wear better and more evenly than those of alloy iron



Rollers used in stationary tests of automobiles are now made of ductile iron because of its high wear resistance

iron, it is reported that the teeth are now replaced only at five week intervals. In this application, ductile iron not only wears 12 times as well as machinery steel but it costs about 12 per cent less. It stands up equally well under both dry and wet wear.

Other foundry reports state that the material has outworn forged steel, some alloy steels and other materials utilized for certain fiberizer hammers used in the asbestos industry. Although this success has been achieved without redesigning, a special design is now being developed to make the hammers even more durable.

Experiments today are being conducted with freight car wheels made of ductile iron. They are expected to give longer life and better shock resistance than cast-iron wheels in current use.

It is generally reported that ductile iron is exceptionally well suited for such applications as (1) replacement for conventional cast-iron where greater strength or resistance to impact is needed; (2) replacing large malleable iron castings which have been difficult to produce; (3) replacement for steel castings where better castability or machinability is required; (4) in certain heat resisting applications requiring wear resistance as well; and (5) for abrasion resistance and toughness, combining a hard chilled surface with a ductile core or back.

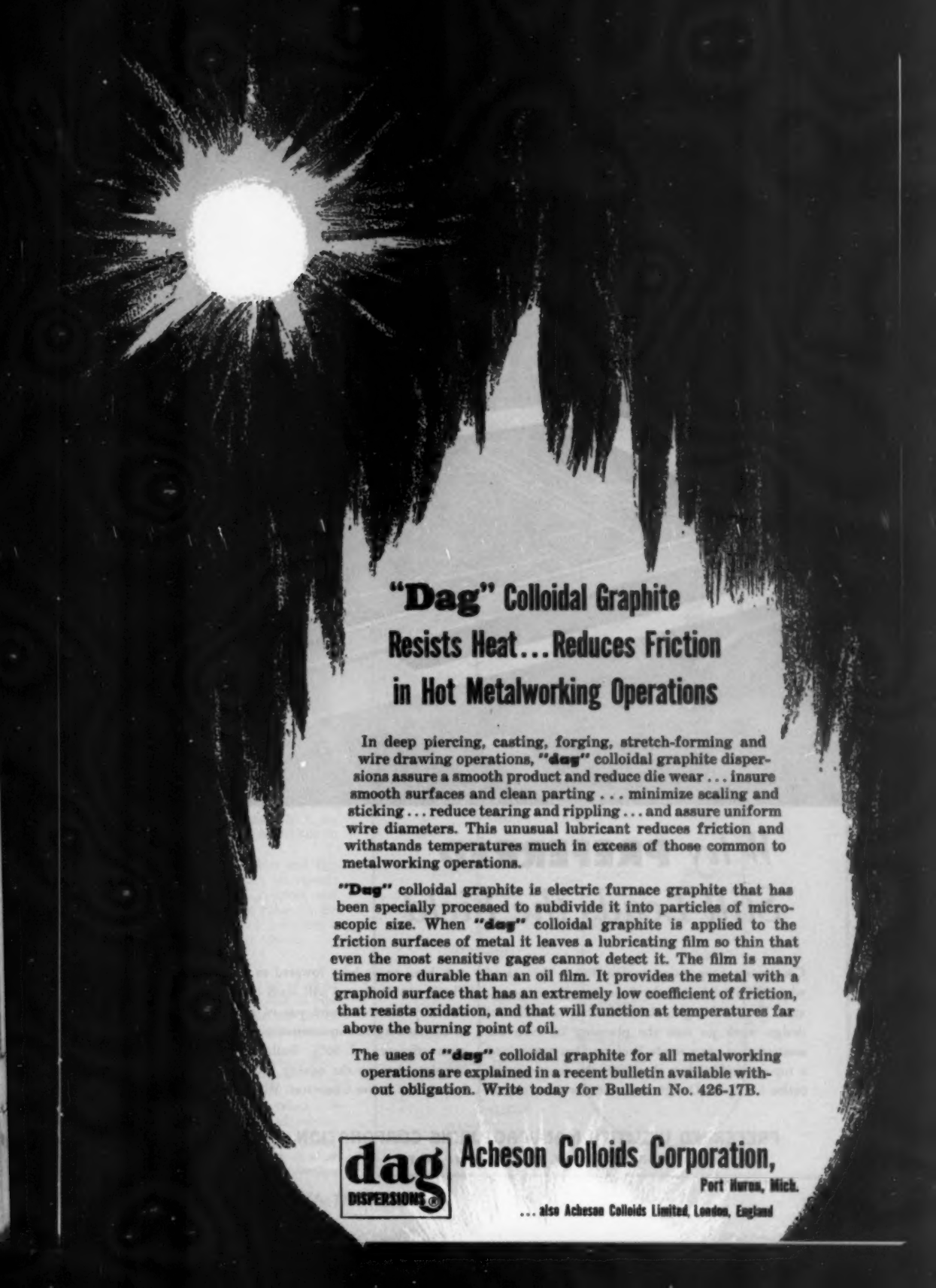
Experiment in Nuclear Generation of Power Successful

Small amounts of electric power have been produced from heat energy released in the operation of the experimental breeder reactor, recently completed at the National Reactor Testing Station in Idaho. In a trial run electrical power of more than 100 kw was generated and used to operate pumps and other reactor equipment along with providing light and electric facilities for the building.

The heat energy generated was removed from the reactor by a liquid metal at a temperature high enough to generate steam to drive the turbine.

The principal function of the breeder reactor is the long range goal of converting nonfissionable material into fissionable material more rapidly than nuclear fuel is consumed, a process which would contribute to expansion of the current atomic weapons program. The power generation phase is incidental but is being carried out to secure experimental information on the handling of liquid metals at high temperature under radioactive conditions and on the extraction of heat from a reactor in a useful manner. The system at the breeder reactor can never generate large amounts of electrical power but it does provide a useful tool for carrying out such experimental studies.

No comparisons should be made of the cost of producing electric power from this reactor with power from conventional sources, since cost is not an essential factor in the power phase of the Idaho reactor. The experiment is not intended to establish the feasibility of producing electrical power economically from nuclear sources; however the information gained may be useful in the design of future reactors to generate electricity at a competitive cost.



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Handbook for engineered plant services

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STEAM FLOW IN STRAIGHT LINE PIPE

The Fanning formula for the flow of steam can be written in the form:

$\Delta P_{100} = C_1\ C_2\ C_3\ V$

C_1 = discharge factor
C_2 = size factor
C_3 = viscosity factor
ΔP_{100} = pressure drop per 100 ft of pipe, in psi
V = average specific volume of steam

Typical examples loosely demonstrate how this formula and the accompanying tables can be utilized to determine pressure drop, rate of flow, and the minimum pipe size for different steam services.

Pressure Drop

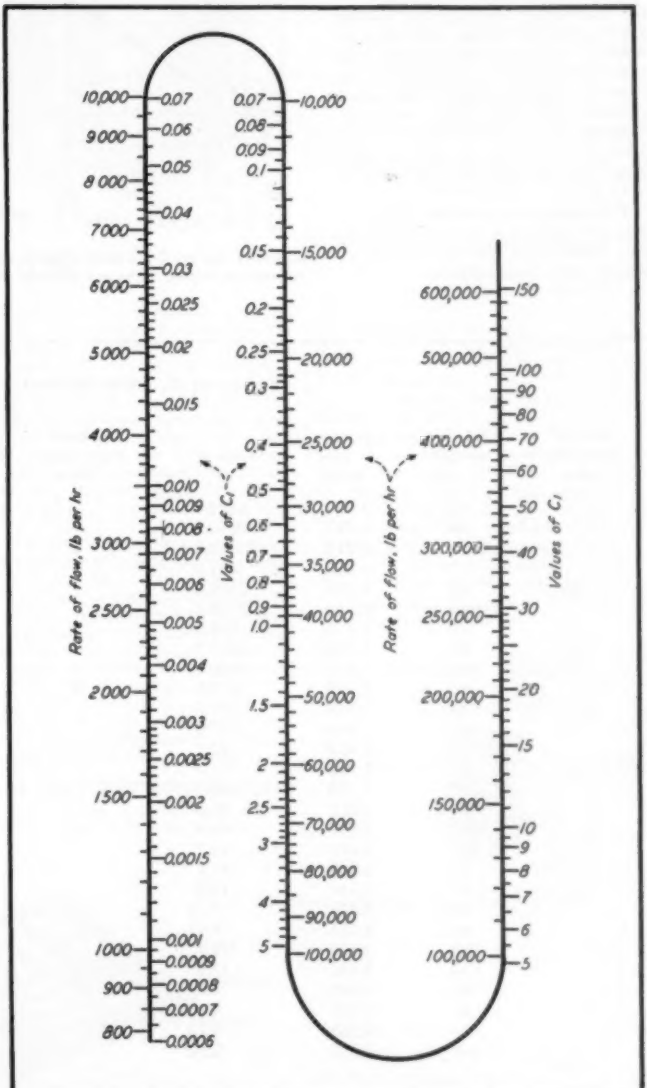
Problem 1: Find the pressure drop in 100 ft of 8-in Standard (Schedule 40) pipe if the steam pressure and temperature are 360 psi and 500 F, respectively. The discharge is 240,000 lb per hr.

Solution: From the tables and figures, the following values are found: C_1=26.7, C_2=0.263, C_3=0.996, and V=1.45. Inserting these values in the steam flow formula and solve for ΔP_{100}, gives 10.14 psi per 100 ft.

Rate of Flow

Problem 2: Find the rate of flow, in lb per hr, in a 4-in Schedule 40 pipe if the pressure drop is 8 psi per 100 ft. Saturated steam at 150 psia is flowing in the pipe.

Solution: From the given conditions and the tables and figures: ΔP_{100} =8.0, C_2=7.73, C_3=0.972, and V=3.0. Substituting these values into the steam flow formula and solving



Discharge factors, C_1, are found by the simple expedient of locating rate of flow and obtaining adjacent reading

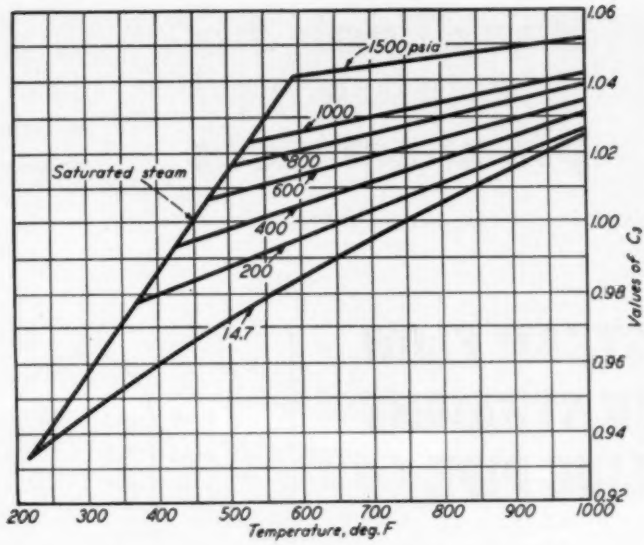
for C_1, gives a value of 0.355. By referring to the Fig. 1, the discharge for this value of C_1 is 23,600 lb per hr.

Pipe Size

Problem 3: Find the smallest size of Schedule 40 (Standard) pipe that can be used for a process requiring 20,000 lb of saturated steam per hour, if the initial steam pressure is 100 psia and the maximum allowable pressure drop is 10 psi per 100 ft of pipe.

Solution: From the given conditions and the tables and figures: $\Delta P_{100} = 10$, $C_1 = 0.257$, $C_3 = 0.96$, and $V = 4.432$. Substituting these values in the steam flow formula, and solving for C_2, gives 9.2. From the table, 4-in. Schedule 40 pipe is the smallest size that will provide a value of C_2 less than the calculated value. The actual pressure drop per 100 ft of 4-in. Schedule 40 pipe may now be calculated as 8.5 psi by solving the steam flow formula using the table value of 7.73 for C_2.

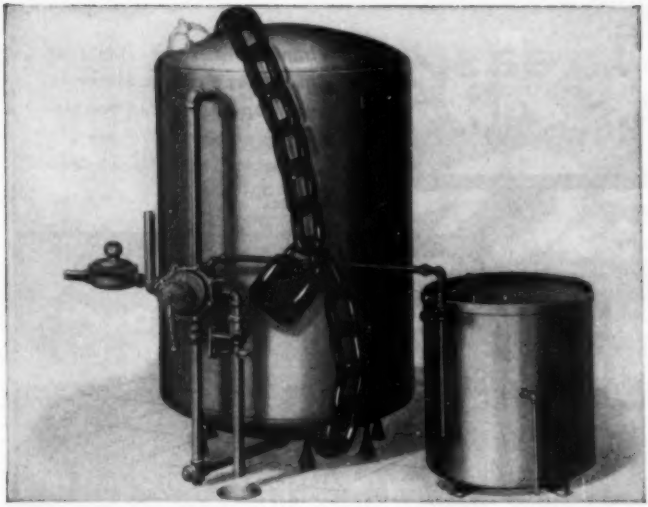
Information contained in this article was compiled from data submitted by the Crane Co. Acknowledgment is hereby made for these data.



Viscosity factor, C_3, is determined from steam pressure and total temperature. At saturation employ curve as indicated. When superheated interpolate between curves

Values of C_2 (Size Factor)

Nominal pipe size, inches	Schedule number of pipe	Internal diameter of pipe, inches	Value of C_2	Nominal pipe size, inches	Schedule number of pipe	Internal diameter of pipe, inches	Value of C_2
	40	1.049	6420.0		40	6.065	1.00
1	80	0.957	10050.0		80	5.761	1.28
	160	0.815	21950.0	6	120	5.501	1.62
	40	1.380	1687.0		160	5.189	2.16
1¼	80	1.278	2455.0		30	8.071	0.249
	160	1.160	3935.0		40	7.981	0.263
	40	1.610	755.0		60	7.813	0.291
1½	80	1.500	1067.0		80	7.625	0.328
	160	1.338	1860.0		100	7.439	0.369
	40	2.067	213.0	8	120	7.189	0.435
2	80	1.939	291.0		160	6.813	0.568
	160	1.689	570.0		30	10.136	0.0819
	40	2.469	80.1		40	10.020	0.0866
2½	80	2.323	121.0		60	9.750	0.0980
	160	2.125	188.0		80	9.564	0.109
	40	3.068	31.2		100	9.314	0.1235
3	80	2.900	40.9	10	120	9.064	0.141
	160	2.626	66.7		140	8.750	0.168
	40	3.548	15.0		160	8.500	0.193
3½	80	3.364	19.5				
	40	4.026	7.73		30	12.090	0.0344
	80	3.826	9.91		40	11.938	0.0366
4	120	3.626	12.8		60	11.626	0.0420
	160	3.438	17.5		80	11.376	0.0467
	40	5.047	2.57	12	100	11.064	0.0534
5	80	4.813	3.18		120	10.750	0.0615
	120	4.563	4.22		140	10.500	0.0690
	160	4.313	5.52		160	10.126	0.0823



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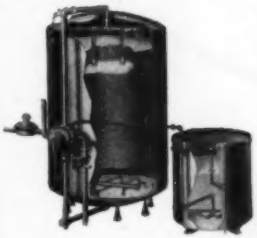

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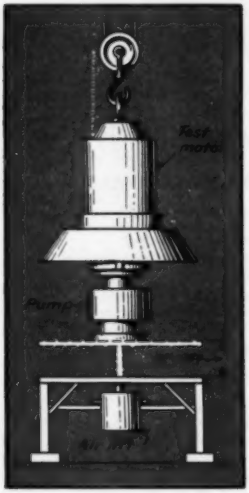
Practical Ideas

Kinks . . . . . How To's

Improvised short cuts that are practical solutions to your operating and maintenance problems. We pay $10 on acceptance of each idea

Air Hoist Simplifies Pump-Testing Setups

The illustrated platform lift simplifies and makes for safer pump testing operations on Allis-Chalmers' erecting floor. It is capable of handling 1600 lb, which exceeds the weight of the heaviest pump tested.



The lift consists of a pneumatic cylinder suspended between the test stand and parallel to the cylinder ram. A 1x19x35 in. plate serves as the platform. Keys which move in a keyway are fastened to the platform to keep it from tipping. The ram has a 6 in. lift supplied with 90 lb of air.

Before the lift was used, the 50 hp testing motor was set on top of the pump by means of a jib crane. This was a rather hazardous undertaking because the motor weighs 1800 lb and a close fitting spline had to be engaged. Also, it required two men: one to operate the crane and the other to guide the pump and motor spline together.

Now one man can do the job safer by hanging the motor about 4 in. above the pump on the air hoist platform, and by admitting enough air to raise the pump into place for bolting to the test motor.

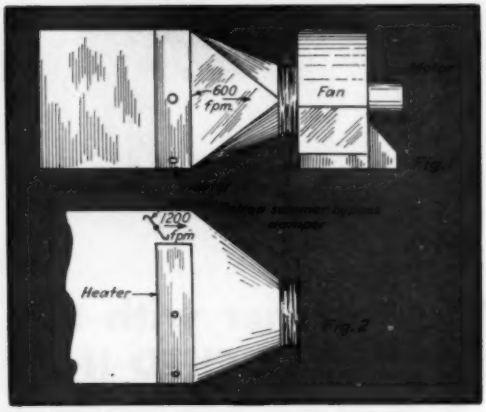
Thomas Manning, Milwaukee, Wisc.

Heater By-Pass Damper Improves Ventilation

Heating and ventilating units installed in one of our plants were fabricated as shown in Fig. 1. During the heating season, dust accumulated on the extended-surface heating coil and caused a buildup of resistance from 0.125 to 0.21 in. w.g. As a result, original air flow of 5500 cfm dropped to 2200 cfm.

When the summer ventilating season came, excessive heating of the space forced us to develop some means to reduce the resistance across the coil other than cleaning the fine surfaces. During this period, steam supply to the coil was shut off and 100 per cent outside air was used for ventilating the space.

It was decided to by-pass the coil by means of a manually operated felted damper sized to cause a velocity of 1200 fpm. Fig. 2 shows this development. Damper blade is 18 gage steel and leak-proof when closed during the heating period. The arrangement provided for the proper cleaning schedule to be maintained. After cleaning, the coil passed

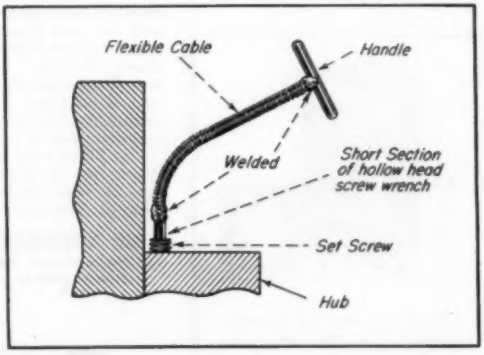


a sufficient volume of air for summer ventilation without over-loading the fan motor.

John D. Constance, Cliffside Park, N. J.

Flexible Hollow-Head Screw Wrench

Time can be saved by using the illustrated wrench for running hollow-head and other type setscrews into wheel, pulley and gear hubs and other locations where an ordinary hollow-head screw wrench cannot make a full turn. The



wrench consists of a straight section of a regular hollow-head screw wrench welded to a short length of flexible cable, such as a discarded flexible shaft or small-diameter drain cleanout cable. A short length of steel rod is welded to the other end of the flexible cable to serve as a handle. After a screw has been run up as far as possible with the flexible wrench, a regular wrench should be employed for final tightening.

Thomas Trail, Catonsville, Md.

Check First with Dutton

FOR ONLY THE DUTTON ECONOTHERM
GIVES YOU OFF-CENTER FIRING

AND
...HERE'S THE EXTRA ADVANTAGE OF
OFF-CENTER FIRING

Induces positive, fast water circulation in a rotary motion, resulting in uniform water temperature in shell . . . faster steaming . . . elimination of surging and priming . . . a steady water line at all times . . . higher quality, dry steam . . . and a higher column of water above the furnace. Every point makes sense — makes performance too!

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ROTARY COMBUSTION
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UNUSUAL EFFICIENCY, SAFETY
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GAS, HEAVY OIL, LIGHT OIL FIRING

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ECONOTHERM
Bulletin
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Other types and sizes —
5 to 250 h.p.
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in Phone Book for
Dutton Representative.

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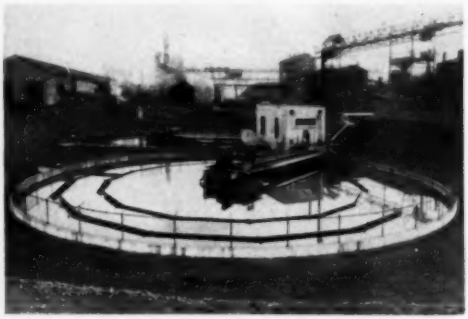
Spot news

Short, "boiled-down" paragraphs on the most interesting recent events and developments in American industrial plants

Concrete Thickening Basins Installed at Jones & Laughlin Minimize Stream Pollution

In order to minimize the serious situation of pollution of the nation's streams by industrial wastes, many industries have recently installed water clarification systems or have made improvements on existing installations. One such new installation is that of two 105 ft dia concrete thickening basins at the Jones & Laughlin Steel Corporation's Aliquippa Works. These basins, constructed by Dravo



Two 105 ft diameter Walker concrete thickener basins clarify water and recover tons of valuable iron ore dust

Corporation, replace a blast furnace sludge settlement pond which previously overflowed into the Ohio River.

The new equipment processes water containing valuable iron ore dust to remove the solids, which are filtered and treated for re-use in blast furnaces. Tons of usable iron ore are recovered daily in this operation. The water drained into the river is cleared of solids and because the previous settlement pond occupied an area of approximately 130,000 sq ft, some 100,000 sq ft of additional land is now available.

There Is Scrap Wherever There Is Business

As the nation's stockpiles dwindle, the need for scrap becomes increasingly urgent. Recently three open hearth furnaces at the Gary works of United States Steel Company were shut down, due to a shortage of scrap. This shutdown caused an estimated production loss of 1600 ton of vitally needed steel per day. According to NPA, other furnaces in the large steel producing centers will be closed soon unless more scrap becomes available.

The importance of scrap applies not only to iron and steel, but also to such non-ferrous metals as copper, brass, bronze, aluminum, lead and zinc. Unfortunately there are many business people who feel they can be of little or no assistance to the scrap program because they manufacture or handle non-metallic products. In some cases the quantity of salvage in an individual firm may be small, however in the aggregate it represents very real volume, which at this time of critical shortages, is essential to the defense production program.

In short, wherever there is business there is scrap. That scrap may be "production" or "dormant" scrap. Production scrap normally flows from industrial plants to scrap dealers as quickly as it accumulates. Unless it is being thrown on the dump, it is therefore of little concern to the scrap campaign. It's the dormant scrap which normally does not flow to the mills that's so badly needed today. This is found wherever obsolescence, wear, accident, damage or other cause has brought retirement from active service. Obsolete machinery, tools, jigs, dies, fixtures and other equipment in industry, including items broken, worn beyond repair, abandoned, dismantled or in need of unobtainable replacement parts are examples.

As the scrap supply falls below the demand, much of the output counted on from recent plant expansions will be counterbalanced by the slower production processes that will result from inadequate amounts of scrap. This will

Crane powered by 150 hp Cummins diesel handles hundreds of tons of scrap daily at Woodmere Scrap Iron & Metal Co.

inevitably be reflected in the size of allotments that can be made to consumers under the Controlled Materials Plan. The collection of scrap should therefore be of vital interest to all business men.

Many companies are going all out for the scrap program, putting scrap collection on a "housekeeping" basis. In addition to increasing scrap supplies, continuous scrap recovery from questionable old stand-bys, obsolete machines and equipment reduces taxes through inventory write-off,

(Continued on page 120)

13 YEAR TORTURE TEST

...STILL LIKE NEW!

QUAKER PACKINGS

Provide Positive Seal... Retain Flexibility Despite High Temperatures and Pressures

Here's a seat gasket cut from Ebonite Sheet Packing that rolled up thirteen years of trouble-free service on a pop-off pressure relief valve in a southern plant . . . withstanding high temperatures and pressures . . . eliminating leaks and shutdown time, assuring absolute safety. Only extensive changes requiring different sized gaskets made it necessary to replace this gasket at all!

Performance like this is made possible because of Ebonite's remarkable leak-proof characteristics and the fact that it will not carbonize, melt or become hard. That's why Ebonite is ideal for high pressure joints and flanges; for use with superheated steam, ammonia, brine, air, oils, acids, caustics, gases, hot or cold water.

For all your requirements—whether packings or belting for conveying materials . . . flat or V-belts for driving steam engines, steam turbines or electric motors . . . hose for flushing, suction, cleaning or fire fighting purposes—see your Quaker distributor, or write direct to us.

HOSE FOR RUGGED WEAR

Hose for air, steam, water, oil, gas or paints, Quaker makes it to fit the needs of the Chemical Industry. Each is pre-tested for peak performance.

BELTING FOR MAXIMUM HORSEPOWER

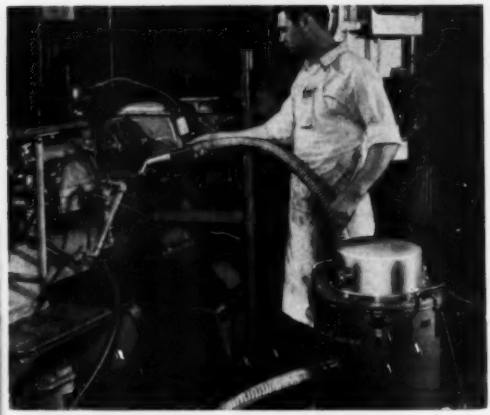
Flat belts or V-belts, Quaker has the one to fit the drive . . . to transmit maximum horsepower at the lowest operating cost . . . all pre-tested to assure peak performance.

QUAKER RUBBER CORPORATION

DIVISION OF H. K. PORTER COMPANY, INC.

PHILADELPHIA 24, PENNA. BRANCHES IN PRINCIPAL CITIES

Economize
on cleaning costs NOW



One worker with *one* G. E. heavy duty cleaner can clean *any* surface . . . pick up small scrap for salvage . . . clean high-up, out-of-reach areas quickly and safely. By using a simple attachment, he can clean *wet* surfaces . . . pick up mop water, toilet overflow, drinking fountain leakage, etc.

G. E. industrial cleaners were designed after thorough survey of industrial cleaning needs. That's why G. E. cleaners have so many time and money saving features.

For instance—nozzles are extra wide (12" and 18") to cover big areas quickly. Motors have extra power to pick up industrial scraps or fine dust with equal ease. Each unit converts quickly to powerful *blower* for collecting coarse litter into convenient piles for easier disposal. These and other features of G. E. cleaners help you get to the root of high cleaning costs—make each of your maintenance workers more productive. **Mail coupon for details.**

Industrial Cleaners

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1285 Boston Ave., Bridgeport 2, Conn.
Without obligation, please send complete details on heavy-duty cleaning equipment.

NAME .....

FIRM .....

ADDRESS .....

CITY ..... STATE .....

Spot news *(Continued from page 118)*

improves safety conditions and appearance of the plant, gives lowered insurance rates and clears valuable space.

The Sun Oil Company recently reported collecting 8000 ton of steel scrap and 70 ton of copper and brass. Most of this scrap resulted from the dismantling of obsolete refinery units, buildings, storage facilities and equipment.

Westinghouse Electric Corporation reports nearly 5000 ton of iron and steel scrap recovered in an intensive three month scrap clean-up campaign in which twenty-two major plants and all manufacturing divisions throughout the country participated. As an example of the thoroughness of this campaign, the company cites one division which turned in a surprising 10,833 lb of scrap as a result of a "Desk and Office Clean-Out Day". Another division surveyed its inventory of dies held by outside suppliers and authorized scrapping of over 200 ton.

In view of the urgent need for the recovery of strategic metals from scrap, The International Nickel Company, Inc., has published a 48-page booklet, "Rapid Identification of Some Metals and Alloys", which outlines simple tests to identify nickel and other strategic metals. This booklet is available without charge from the Development and Research Division, 67 Wall Street, New York 5, N. Y.

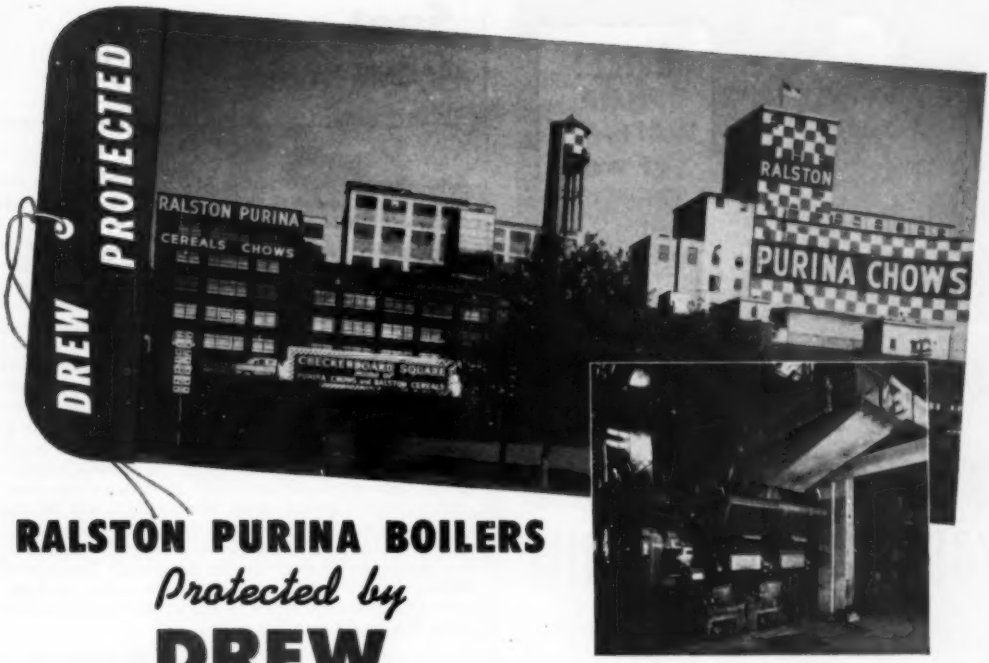
Cathodic Protection System Stops Dangerous Leakage in Hydrogen Plant Underground Piping

Protection for 2200 ft of underground piping at the Wilson & Company hydrogen plant in Oklahoma City, Oklahoma, has been provided by installation of a cathodic protection system. Although this plant was less than five years old when this system, engineered by The Harco Corporation, was installed, a large percentage of the piping had

(Continued on page 122)

BUS DUCT SUPPLIES SINGLE AND THREE PHASE CURRENT

Three phase, 120/208 v, four wire duct system made by Westinghouse Electric Corp. solves problem of supplying single and three phase power to various motor driven machines in United Airlines' San Francisco Maintenance Base



RALSTON PURINA BOILERS
Protected by
DREW
COMPLETE BOILER WATER TREATMENT

Send for your illustrated DREW ORGANICS folder describing the use of organics in modern boiler water treatment. Write today.

POWER DREW CHEMICALS

This landmark on Checkerboard Square in St. Louis is the home office and original plant of Ralston Purina . . . famous Purina Chows and Ralston Cereals. A by-word in millions of homes and farms, Ralston Purina now operates 38 Chow plants across the United States.

Modern boiler water treatment plays an important role in this plant. Pure steam is essential for food processing and Drew complete BWT has protected the boilers for 5 years against steam contamination and other boiler water difficulties.

Many companies, like Ralston Purina, rely on the Drew 3-point program for better power plant operation.

1. Drew engineers make thorough studies of boiler plant operations and water conditions.
2. Drew water chemists and engineers analyze this data in Drew Laboratories and make specific recommendations for treatment.
3. Drew engineers make frequent tests in the plant to assure efficient performance of the water conditioning.

Thoroughness of investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew Boiler Water Treatment and Service. Do the same. Consult the nearest Drew engineer or write for information.

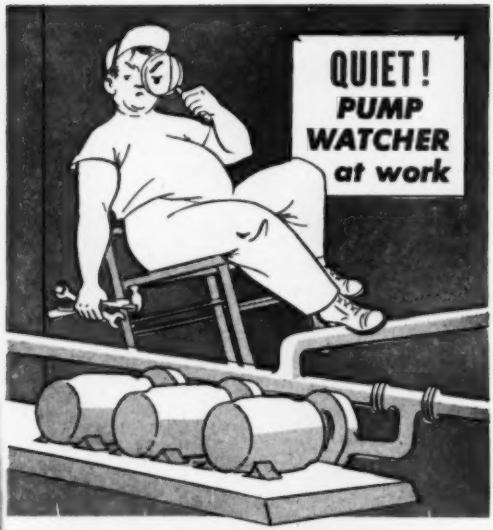
Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

DREW PRODUCTS

Nationwide Service in Boiler Water and Cooling Water Conditioning



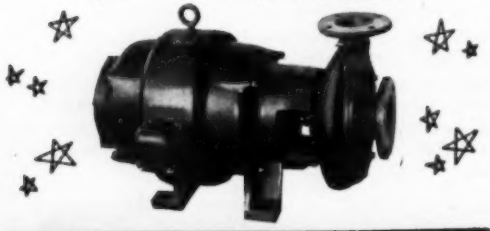
YOU DON'T NEED HIM

When You Employ WEINMAN Pumps

There's no need for a "pump watchman" when WEINMAN liquid handling equipment is on the job. WEINMAN pumps deliver a steady, dependable, though unseen, performance. They require practically no maintenance or upkeep! They do the job RIGHT because they are the result of the correct application of mathematics, proper basic design and specialized hydraulic experience.

The entire WEINMAN ORGANIZATION, including your nearby representative, is anxious to put their pump experience into service for you. Every key man and department head has at least twenty-five years shirt-sleeve experience with Centrifugal pumps. Your inquiry will bring a prompt, helpful and non-obligating reply. Just write, wire or phone.

General Service Unipump for handling liquids economically and efficiently.



Built by Centrifugal Specialists

The WEINMAN Pump Mfg. Co.

286 SPRUCE ST COLUMBUS 8, OHIO

Representatives in Principal Cities

Spot news

(Continued from page 120)

already required replacement and a considerable portion had been patched. In the 12 months following the installation only one leak has been encountered.

Because most piping at this plant is buried in or under concrete, maintenance and replacement operations were very difficult and costly. In addition, a continuous processing cycle is essential to efficient production in this plant, and any leaks which interrupt its 24 hr day operations present a serious problem. An even more serious problem was posed by possible leaks in the propane lines which could permit lethal accumulations of this heavier-than-air gas in underground pockets or in such places as the plant sewage system.

Graphite anodes and a totally oil-immersed Class 1, Group D explosion-proof rectifier were used in this installation. In addition the plant piping was bonded together to make one complete electrical circuit. Water service lines, process solution piping, steam and air lines, and natural gas lines as well as underground conduit are now cathodically protected by a single system. In operation, the rectifier impresses a direct current on the anodes. This current radiates through backfill material and the soil to the metal pipe surfaces to oppose and counteract the electro-chemical action that causes corrosion.

(Continued on page 162)

Conditioned Water

to meet all requirements in all industries...

Automatically!

Belco's experience and manufacturing facilities are unmatched for design and production of automatic panel control of your water processing. Call us next time you consider equipment for removal of water impurities. We're sure that we can help you to your advantage. Belco Industrial Equipment Division, Inc., Paterson 3, N. J.

Belco

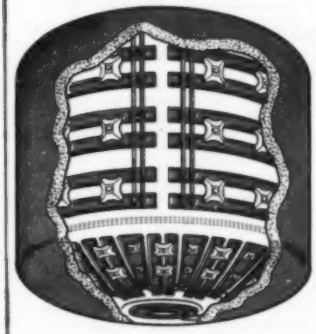
HEADQUARTERS FOR AUTOMATIC CONTROL OF PROCESSES FOR REMOVAL OF WATER IMPURITIES

Industry's Most Versatile Heat Source

Chromalox *Electric* Strip Heaters

Easy to Install CHROMALOX Electric Strip Heaters give clean, dependable and accurately controlled heat where and when heat is needed. They produce uniform and accurate temperatures by automatic or manual controls. Low initial costs, low installation costs and low operating costs are among the many advantages of using CHROMALOX Strip Heaters for heating liquids, gases, viscous fluids, tanks, platens, molds, moving parts, etc. Get the full details now.

A Typical Strip Heater Application from Our Files



Rugged, easily installed Chromalox Strip Heaters assure accurate temperature, dependable around-the-clock service.

Strip Heaters curved lengthwise at the factory fit snugly to tank perimeter and . . .

Strip Heaters curved slightly as installed conform to shape of convex kettle bottom, while . . .

Segment Heaters fill the gaps.

IC-99

CHROMALOX

Electric Heat for Modern Industry

Sizes, Types and Sheaths for Every Need
LENGTHS
4" to 96" lengths, 1" to 2½" widths, rings 2½" to 11" diameter, 115 to 460 volts
CURVES & SEGMENTS
Curved in brass jaw or bar or formed lengthwise to desired radii
TERMINALS
Varied terminal types for convenient wiring. 2 terminals at one end, centered or at opposite ends. 3 terminals at same end of the unit
SHEATHS
Rust-resisting iron, high temperature steel and Monel sheaths to meet exact service conditions

Want Ideas?

on how to use Chromalox Electric Heaters in your plant

Write for the data-packed Catalog 50 which describes many types of Chromalox Electric Heaters and how to apply them. It's yours without obligation.

EDWIN L. WIEGAND COMPANY
7520 Thomas Blvd., Pittsburgh 8, Pa.

News
of men and companies

HONORS

American Society of Heating and Ventilating Engineers—Homer Adams, chairman of the board of the Fitzgibbons Boiler Co., Inc., and only living charter member of the society, received the 1951 F. Paul Anderson Medal for "outstanding work in the field of heating, ventilating and air conditioning." His selection is in recognition of his contributions to boiler design and performance.

SALES OFFICES

Askania Regulator Co.—Established a branch office in Philadelphia, at 1244 Commercial Trust Bldg. R. J. Kroth, formerly of the Chicago sales office, is district mgr.

Black, Sivalls & Bryson, Inc.—Opens another California sales office in San Francisco headed by R. Baze with W. J. May as his assistant. The address is 55 New Montgomery St.

Eclipse Fuel Engineering Co.—New factory and office building in Rockford, Ill., occupies 95,200 sq ft all on one floor. This represents an expansion to triple former quarters.

Griscom-Russell Co.—Administrative sales and engineering departments moved from New York to Massillon, O.

Hewitt-Robins Inc.—The Philadelphia office and warehouse of Hewitt-Robins Inc. moved to Coral and Hagert St.

National Electric Products Corp.—Closed the Philadelphia warehouse and transferred operations to the new plant recently acquired in Linden, N. J. At the same time the Philadelphia sales office moved to Suite 404-5-6 Architects Bldg., 17th and Sansom Sts. L. Clark, is the district mgr.

Omega Machine Co.—L. E. Harper, president, moved from the Wilmette, Ill. district office to the main office in Providence, R. I.

Reliance Electric & Engineering Co.—The new $1,800,000 Euclid (Ohio) plant, located at 24701 Euclid Ave., is now in operation.

Star-Kimble Motor Div.—New Cincinnati sales office, located in the Roselawn Center Bldg., will be in charge of L. Steinmetz. R. L. Palmer heads up the new Milwaukee sales office located at 312 East Wisconsin Ave. T. R. Mahoney, new sales engineer, covers northern New Jersey.

NEW REPRESENTATIVES

Blackmer Pump Co.—Additional distributors who are stocking the entire product line and service parts include Howard Supply Co. of Oakland, Calif., and the Hetler Equipment Co. of Grand Rapids, Mich.

Byron Jackson Co.—Has entered into an escrow agreement with O. L. Bardes of Cincinnati, owner of the A. D. Cook Pump Co., to purchase the assets of his organization located at Lawrenceburg, Ind.

The Dow Chemical Co.—The magnesium sales dept assumes distribution of cathodic protection products from Dowell, Inc., wholly-owned subsidiary.

Charles A. Fowler Co.—Has been named by Zurn Western Services, Inc., as northern California sales representatives. They are located at 889 Bryant St., San Francisco. Newton R. Crum, 181 La Verne Ave., Long Beach, is southern California sales representative.

Hanna Engineering Works—Announced the appointment of Power Transmission Products Div of Portland Iron Works, Portland, Ore., as distributor in the state of Oregon and certain counties in California and Washington.

The Stuart Steel Protection Corp.—Has recently been formed by Linden Stuart as chairman of the board and Linden Stuart, Jr. as president. The offices and warehouse are located at 2 Mark Road, Kenilworth, N. J.

R. A. Fergusson, president, (standing) outlines 1952 plans to the sales organization of the Rust-Oleum Corp.

CHANCELLOR HEALD HEADS CENTENNIAL CONVOCATION

Impetus has been given to the rounding out of the great convocation of national and international engineering societies to be held in Chicago next September as part of the celebration of the Centennial of Engineering, with the election of Chancellor H. T. Heald of New York University to the chairmanship of the convocation committee.

Other members of the committee are E. R. Weidlein, president, Mellon Institute of Industrial Research; F. V. Geier, president, Cincinnati Milling Machine Co., A. P. Greensfelder, chairman, Fruin Colnon Contracting Co.; and E. G. Bailey, v-p, Babcock and Wilcox Company.

During the convocation, there will be individual symposia and technical meetings on problems being encountered in almost every phase of engineering. More than a hundred nationally known speakers will participate.

At least 25,000 representatives of 41 national and international engineering societies are expected for the convocation, according to Major L. R. Lohr, the Centennial president.

National Transmission Distributors, Inc.—Acquires rights, title, interests and good will of Rockwood Pulley Mfg. Co.

Sterling Electric Motors, Inc.—Following additional distributors have been appointed. Industrial Electrical Co. 1244 McHenry Ave., Modesto, Cal.; Butte Machinery Co. 510 E. Aluminum, Butte, Montana; Pomona Electrical Machinery Co., Inc., 260 N.E. End Ave. Pomona, Cal.; Industrial Motor Electric, 449 West Street, Woodland, Calif.; Meyer Brothers Co., Phillipsburg, Pa.; Transmission Equipment Co. 527 Lexington Ave., New York, N. Y.

John Waldron Corp.—Reaches agreement with Anchor Steel & Conveyor Co. to market Anchor cutout and cutout couplings, through their sales representatives.

EXPANSIONS

The H. K. Ferguson Co.—Has been awarded a contract to construct a 240,000 sq ft general supply warehouse at the Erie Ordnance Depot in Lacarne, Ohio.

Fine Organics, Inc.—Has approved plans to enlarge building to house increased laboratory and production facilities at the Lodi, N. J. plant.

M. W. Kellogg Co.—Has been awarded a $75 million contract for the field-fabrication and erection of some 50 million lb of process and auxiliary piping and related equipment in the two major gaseous diffusion units now well underway at the AEC installation located in Paducah, Ky.

William F. Klemp Co.—Announced plans for additional expansion in 1952, approximating $500,000.

Luscombe Airplane Corp.—A $450,000 building program which will

(Continued on page 126)

Burn REFUSE or COAL

With DETROIT STOKERS

Successful Installations Burn

Hogged Wet or Dry Bark
Hogged Wood
Wood Shavings and Sawdust
Wood Sander Dust
Spent Tan Bark
Corn Cobs
Coffee Refuse
Oat Hulls
Coconut Shells
Tobacco Stems
Leather Scraps
Peanut Shell Refuse

—Either separately or in combination with coal, oil or gas

The use of the Detroit RotoStoker and RotoGrate Stoker for various kinds of waste materials, followed quite naturally its established use for burning an extremely wide range of Coals, as well as high moisture Lignite.

Through the years, installations with steam boilers of a wide range of types and sizes have been made for burning waste materials.

If you have combustible refuse, the best disposal method is *burning it* which will avoid nuisance or pollution and at the same time will salvage the fuel value.

Detroit RotoStokers and Detroit RotoGrate Stokers are readily adapted and highly successful for refuse burning.

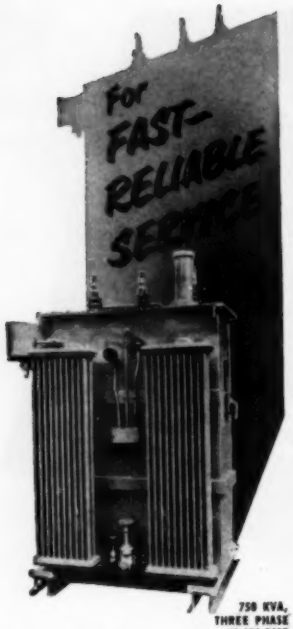
Write for this 24 page Booklet 505 which gives Engineering data on our refuse burning installations.

DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

General Motors Building • Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Mich.



750 KVA, THREE PHASE 13,800-2400 with NEMA Std. Accss.

demand

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DISTRIBUTION & POWER TRANSFORMERS

Today—more than ever before—more and more organizations are specifying STOCKWELL—Why? It has superior Q-U-A-L-I-T-Y! This—plus the fact that STOCKWELL DELIVERY IS BETTER THAN GOOD—is why you, too, should use STOCKWELL TRANSFORMERS NOW.

mail coupon today!

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Title .....

Company .....

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STOCKWELL
TRANSFORMER CORPORATION
884 W. Waterloo Road
Akron 19, Ohio

News

of men and companies

(Continued from page 124)

add 85,000 sq ft to the permanent building area was announced.

Reynolds Metals Co.—A Letter of Intent for the engineering and construction of a $42 million alumina plant in San Patricio County, Texas, has been issued to C. F. Braun & Co., of Alhambra, Calif.

Union Carbide and Carbon Corp.—Construction of a major unit for the production of polyethylene resins is announced. It will be an addition to the Texas City plant of Carbide and Carbon Chemicals Co., Div.

Whitney Chain Co.—New building under construction contains approximately 10,000 sq ft of additional floor space.

Yeomans Brothers Co.—Construction of a new one story factory, with 92,000 sq ft of floor space, has been started in Melrose Park, Ill.

APPOINTMENTS

Aluminum Company of America—J. W. Schreiber retired as chief construction engineer after 42 years service. He is succeeded by L. B. Kuhns, who was advanced from the position of genl supt of construction. Dr. K. R. Van Horn is appointed to the post of director of research.

Allis-Chalmers Manufacturing Co.—W. M. Wallace has been appointed an asst to v-p of general machinery div.

American Brake Shoe Co.—E. P. Biggs was elected a v-p. He is also president of the Brake Shoe and Castings Div.

Ampco Metal, Inc.—Recently announced the appointment of B. R. Hecker as field engineer in the Detroit office.

O. C. Keckley Co.—Has appointed K. E. Lankton in charge of the industrial distributor dept.

The Babcock & Wilcox Co.—J. H. King, v-p, is named to head the reorganized boiler div of the company

J. H. King L. E. Sawyer

and L. E. Sawyer and E. A. Livingstone, president and v-p respectively of the recently absorbed subsidiary tube company have been elected v-ps of the company. M. Nielsen is now an assistant v-p. He will report directly to C. H. Gay, v-p in charge of manufacturing, and will assist in operations of all plants in the boiler div.

Bogue Electric Mfg. Co.—Promotes J. J. Carlson from asst plant production mgr to works mgr.

Borg-Warner Corp.—W. W. Kovalick is promoted from chief engineer to production mgr of the Chicago plant of the Ingersoll Products Div. He succeeds J. W. Dean, resigned. H. T. Burke, formerly chief tool engineer, becomes acting chief engineer.

BullDog Electric Products Co.—D. H. Anderson, formerly with Kuhlman Electric Co., is appointed advertising and sales promotion mgr.

Detrex Corp.—A. H. Harris is named products mgr of the Phosphate Coating Div.

The Dow Chemical Co.—G. J. Zahringer, Jr. has joined the company at their Midland, Mich. offices to assist in the development sale of solvents for industrial applications. Dr. Wm. Hirschkind is appointed technical adviser to L. I. Doan, president. R. G. Heitz replaces him as Western Div. research director.

The Electric Products Co.—Announces that Dr. W. A. Thomas has joined their engineering staff.

On the occasion of his retirement as director of steam turbine engineering, H. P. Dahlstrand (third from left) accepts best wishes from (left to right) R. M. Casper, W. A. Yost, Jr., and R. N. Miers, Allis-Chalmers executives

General Electric Co.—W. E. Ruder retired from the research laboratory after more than 44 years of service. C. S. Jones and J. R. Conley are appointed district representatives for the Construction Materials Div. Jones is assigned to the north central district with offices at 5726 W. 51st St., Chicago. Conley's offices are at 2431 Hennepin Ave., Minneapolis. A. R. Hines is elected a commercial v-p of the marketing services div. M. B. Elliott, mgr of the unit equipment div, is granted leave of absence to serve in an advisory capacity with the National Production Authority in Washington, D.C.

Dearborn Chemical Co.—E. M. Converse, senior v-p, has retired after almost a half century of service. Although his retirement is in keeping with company policies, he will continue to serve the company as necessary.

L. J. Carson

E. M. Converse

Link-Belt Co.—L. J. Carson, former genl mgr of the Minneapolis plant, resigned from his position as Price Executive of Machinery Branch of the Industrial Materials and Manufactured Goods Div of OPS in Washington, D. C., Dec. 31, 1951, and has been named genl mgr of the new Colmar, Pa. plant. This plant is now under construction and is scheduled to be in operation during the last quarter of 1952.

Greer Hydraulics, Inc.—Appointment of A. K. Atkinson, Jr. as sales mgr of the industrial div is announced.

John J. Harte Co.—Appointment of W. C. Davis as genl sales mgr is announced.

Hewitt-Robins Inc.—G. V. Migula joins as mgr of the western sales div with headquarters at San Francisco. He replaces J. H. Hayden, who is retiring but will continue to serve in an advisory capacity. M. D. Austin will also join the western sales div as district mgr of the Hewitt Rubber Div. K. L. Way replaces Austin as mgr of hose sales and development. The formation of a new south central sales div is announced. L. C. Holloman is named asst div mgr of the new div. Headquarters are at Houston, Texas. N. M. Godfrey is appointed mgr of the eastern sales div.

I-T-E Circuit Breaker Co.—Effective Dec. 31, 1951 the Railway and Industrial Engineering Co., wholly owned subsidiary, ceased doing business as a separate company. Henceforth it will be known as the R&IE Equipment Div., and will continue all of its present operations in Greensburg, Pa. K. S.

(Continued on page 129)

NEW, VALUABLE BOOKLET ON STATIONARY AIR COMPRESSORS

Latest Data on HOW to Save and WHY You Save By Using SCHRAMM

12 color pages include:

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- Space-Saving Advantages
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Flow Stubborn Materials
Thru Bins, Hoppers
And Chutes

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"Pulsating Magnet"
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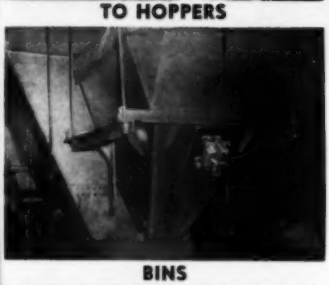
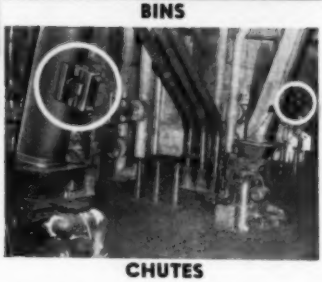


BINS



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Whether it's a small 1 cu. ft. hopper or a big 100 ton bin — there is a Syntron Vibrator that will eliminate arching and plugging.

If you have such a problem, send us the details.

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425 Lexington Ave. Homer City, Pa.

Reviews of recent books . . .

Recent books, published for men responsible for the Engineered Plant Services, are reviewed here. Write to the publisher for those in which you are interested

Wiring

"National Electrical Code Handbook", seventh edition, by Arthur L. Abbott. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. 650 pages, illustrated with drawings, photographs, diagrams and tables. Price $6.00.

Seventh edition of this standard handbook tells how to handle all types of wiring and installation jobs in strict accordance with NEC. Completely revised, it includes all changes, new rules, etc., given in the 1951 National Electrical Code. It explains rules and measurements for all jobs—what they mean —how to apply them. Planned for quick reference by practical men, the handbook can be used also by anyone who wishes to make a thorough study of the Code. This book explains the general plan, scope, and purpose of the National Electrical Code requirements. It makes practical application of rules clear and understandable, and contains Code definitions; descriptions of the 15 types of wiring recognized by the Code for use in light and power systems rules for installation of commonly used materials and apparatus for any standard wiring installation; and the general requirements for services, grounding, automatic overcurrent protection, and wiring installation design.

Industrial Furnaces

"Industrial Furnaces", fourth edition, by W. Trinks, professor emeritus of mechanical engineering, Carnegie Institute of Technology. Published by John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. 526 pages with sketches, diagrams and tables. Price, $10.00.

Since its initial publication in 1923, this book has been regarded by all practicing engineers as a thorough exposition of all phases and problems of practical technology. This book not only discusses the basic principles underlying all furnace design and operation, provides numerous graphic illustrations and typical examples which reinforce the text, but it also offers conclusions—rather than untried theories—which have been tested and proved in actual furnace practice.

The fourth edition of Volume I brings this valuable treatise completely up-to-date by incorporating the most recent scientific facts discovered about heat transfer and furnace design, as well as present day design and operating principles and techniques. Arrangement of subject matter remains much the same as the third edition with the exception that infrequently used material has been moved to the appendix. The volume is divided into sections on capacity, economy, thermal efficiency, strength and durability, and movement of gases in furnaces. About 40 per cent of the text has been rewritten and 94 new illustrations have been added. The tables have been brought up-to-date and many of the statements have been clarified.

Meetings and exhibitions

Announcement of coming meetings that will aid executives and engineers in planning itineraries. For additional information, please write sponsors of meetings

FEBRUARY

Instrument Society of America. The New York Section announces that plans are rapidly developing for its Power Plant Symposium to be held at the Hotel Statler, New York, Feb. 7-8, 1952. Contact Richard Rimbach, 551 5th Ave., New York 17, N. Y.

MARCH

National Power Show—Midwest Power Conference. Being held concurrently March 25-28, 1952, at the Hotel Sherman, Chicago, Illinois. Write A. F. Thompson, Director of Exhibits, 176 West Adams Street, Chicago 3, Illinois.

National Association of Corrosion Engineers holds its Eighth Annual Conference and Exhibition at the Pleasure Pier in Galveston, Tex., March 10-14, 1952.

National Plastics Exposition will take place in Exposition Hall, Philadelphia, March 11-14, 1952. For further information write Harry W. Smith, Inc., 507 Fifth Ave., New York 17, N. Y.

Chicago World Trade Conference will be held in the Hotel Sherman March 6-7, 1952. The Chicago Assn. of Commerce and Industry, 1 N. LaSalle St., Chicago.

Chicago International Trade Fair is scheduled for March 22 through April 6, 1952, at Navy Pier. Headquarters Merchandise Mart, Chicago 54, Ill.

American Society of Tool Engineers holds its 9th Bi-ennial Industrial Exposition in Chicago, March 17-21, 1952, at the International Amphi-theatre. ASTE headquarters 10700 Puritan Ave., Detroit 21, Mich.

APRIL

American Society of Lubrication Engineers holds its Seventh Annual Meeting and Lubrication Show at the Hotel Statler in Cleveland, Ohio, April 7-9, 1952.

News

of men and companies

(Continued from page 127)

Nevin has been elected a v-p of the parent company and mgr of the div. W. M. McCauley and G. L. Carlisle have been elected v-p and coml v-p.

The Lunkenheimer Co.—Under a new arrangement of sales territories, the United States will be divided into three sales areas—an eastern div, under M. W. Pauly, sales mgr; central div, headed by H. H. Layritz, sales mgr; and western div, directed by C. W. Burrage, sales mgr. R. J. Sardieck, with headquarters in Philadelphia, has been appointed district mgr in the eastern div. E. R. Tieberman has been named district mgr in the central div with headquarters in Dallas, Tex. C. B. Rosser, Jr., district mgr, will head the western div with headquarters in Los Angeles.

National Electric Products Corp.—Names J. J. Gretter, Jr., asst service mgr.

Edwin L. Wiegand Co.—J. McOrlly, chief engineer since 1940, is now v-p in charge of engineering. L. D.

J. McOrlly L. D. Drugmand

Drugmand has been named his successor as chief engineer. J. W. Bailey, personnel director since 1944, becomes v-p in charge of industrial relations.

The Permutit Co.—Announces appointment of C. R. Poore as asst sales engineer for its sales office located at 831 E. Morehead St., Charlotte, N. C.

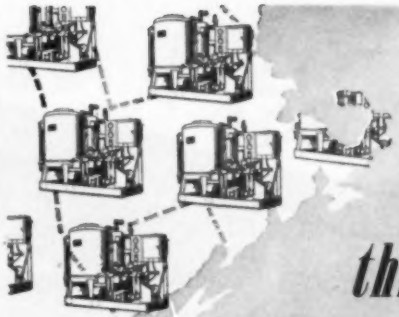
Quaker Rubber Corp.—H. M. Sossaman is elected v-p in charge of commercial development. J. R. Lewis succeeds him as genl mgr.

Raybestos-Manhattan, Inc.—R. B. Hazard is appointed sales mgr of the Packing Div. He will make his headquarters at the Manheim, Pa. plant.

The National Supply Co.—C. K. Olson named asst genl mgr of Engine Div.

Westinghouse Electric Corp.—G. W. Jernstedt is appointed mgr of engineering for the special products development div.

Weston Electrical Instrument Corp.—Promotion of P. Barnes to director of the sales div is announced. H. M. Ricks is now sales mgr, with A. G. Koenig continuing as genl sales mgr of the Tagliabue Instruments Div.



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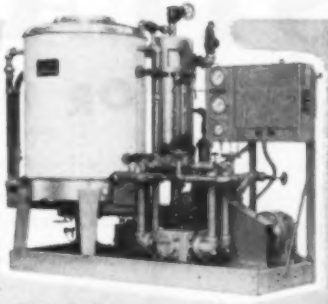
THERE ARE MORE *Clayton* FORCED RECIRCULATION STEAM GENERATORS IN USE THAN *ALL OTHER PACKAGE TYPE BOILERS COMBINED

*Self contained steam generators of from 15 to 100 horsepower



for the reason and proof of this statement mail the coupon

THIS COUPON BRINGS **PROOF** TO YOUR DESK

An animated, colored flow chart shows you how and why the Clayton Forced Recirculation principle can cut your steam costs.

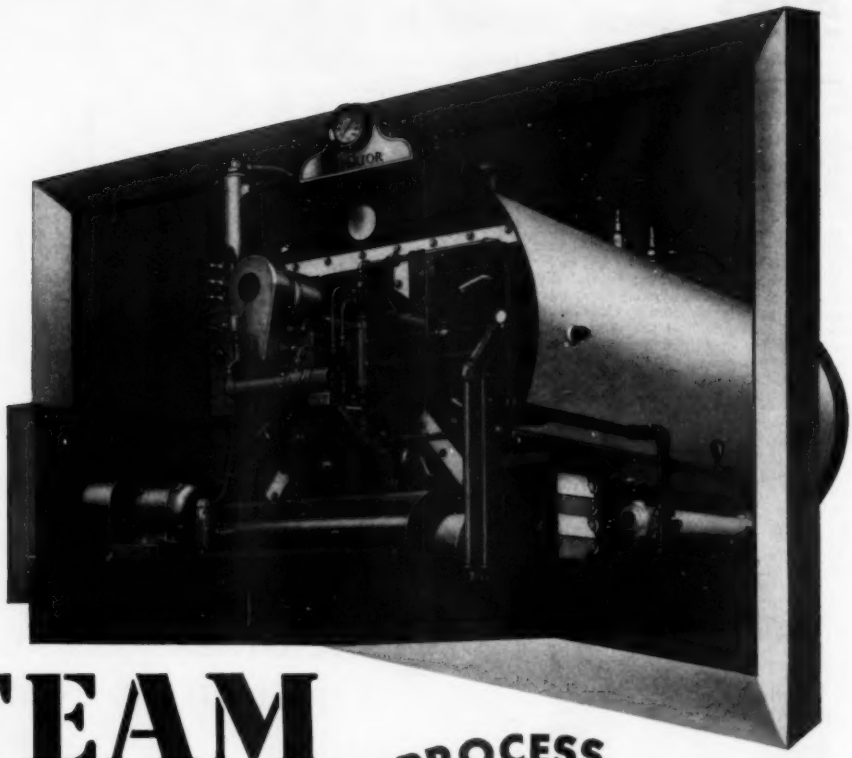
IP-2

CLAYTON MANUFACTURING COMPANY
Box 550, EL MONTE, CALIFORNIA

Send name of nearest distributor and arrange desk demonstration of Clayton Forced Recirculation principle. Send catalog.

NAME_____
FIRM_____
ADDRESS_____ STATE_____
CITY_____

Clayton
MANUFACTURING COMPANY
Box 550, EL MONTE, CALIFORNIA



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A complete steam plant whose heavy duty construction assures long-lived dependability throughout years of hard usage.

- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides ample heating surface . . . at minimum, 5 sq. ft. b.h.p.
- Built-in induced draft fans provide added safety and eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Burner equipment to suit your fuel; gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.

If you are planning new or additional steam facilities, you'll want Catalog 402 which tells all you should know about packaged steam plants.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.

SUPERIOR
STEAM GENERATORS

3 *special departments featured monthly to give you FREE bulletins, catalogs and product data screened for your personal interest in*

ENGINEERED PLANT SERVICES

1. NEW EQUIPMENT

Begins on page 8

Contains highlights of new products by leading manufacturers, briefed and illustrated for your easy reference. Complete data on each of these products are available **free.**

2. NEW BULLETINS

Begins on page 24

Includes descriptions of only those bulletins and catalogs that are really **new** and of **direct value** to you — saves your reading time, yet gives you full service. All bulletins sent to you **free** on request.

3. READERS GUIDE TO ADVERTISED PRODUCTS

Begins on page 133

Designed to catalog advertised products for your convenience in finding the ads which are of special interest to you at this time. Also lists those important bulletins, catalogs and working data offered **free** in the advertisements.

REQUEST CARD FOR LITERATURE OR MORE INFORMATION—Feb., 1952

To: INDUSTRY AND POWER, St. Joseph, Mich. Please have forwarded to me, at no obligation, the literature I've indicated by the following key numbers:

New Equipment begins Page 8	*New Bulletins begins Page 24*	*Advertised Products begins Page 133*
No's	No's	No's

Your Name _____ **Title** _____

Your Company _____

Co. Address (St. & No.) _____

City _____ **State** _____

Inquiries for items listed in this issue not serviced beyond June 1, 1952

FIRST CLASS
PERMIT No. 19
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1. NEW EQUIPMENT

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Your Name _____ **Title** _____

Your Company _____

Co. Address (St. & No.) _____

City _____ **State** _____

Inquiries for items listed in this issue not serviced beyond June 1, 1952

Readers' guide to advertised products

This department is both a product index for advertising and a keyed listing for advertised literature. Refer to advertisement on page indicated and contact advertiser directly—or list paragraph key numbers on reader service card (page 131) to get data you want

AIR & DUST FILTERS & COLLECTORS

Dust Collectors **500**
Aerotec Design 3 RAS Dust Collector. The Thermix Corporation. Adv. page 32.

Dust Collector **501**
Illustrated "Dust Recovery" bulletin describes Buell Dust Collection Systems. Buell Engineering Co. Adv. page 138.

ANTI-CORROSIVE & PROTECTIVE COATINGS

Rust Preventive **502**
Adv. page 35 contains coupon for complete information on Rust-Oleum sealing compound. Rust-Oleum Corp.

BOILERS & BOILER ACCESSORIES

Steam Generators **503**
Information on Foster Wheeler reheat steam generators. Foster Wheeler Corp. Adv. pages 36, 37.

Boilers **504**
Information on Riley single header hopper bottom pulverized coal-fired boiler units. Riley Stoker Corp. Adv. pages 22, 23.

Steam Generators **505**
Information on Union 2 Drum Type "VO" Steam Generating Units. Union Iron Works. Adv. page 39.

Steam Generators **506**
Descriptive literature on Wickes' complete line of steam generating equipment. The Wickes Boiler Co. Adv. page 181.

Boilers **507**
Complete catalogs and information on Kewanee heavy-duty boilers. Kewanee Boiler Corp. Adv. page 141.

Boilers **508**
Information on Vertical Unit Boilers. Combustion Engineering-Superheater, Inc. Adv. pages 10, 11.

BUILDING HEATING, VENTILATING, AIR CONDITIONING & REFRIGERATION

Ventilators **509**
Complete data on Vano Design "A" ventilator. Adv. page 27 contains coupon listing special uses of blowers. Coppus Engineering Corp.

Air Conditioning **510**
Information on Trane heating, cooling, ventilating, and air conditioning. The Trane Co. Adv. page 147.

BUILDING MATERIALS & MAINTENANCE

Pipe Joint Compound **511**
Free sample of Key-Tite waterproof sealing compound. Key company. Adv. page 178.

Industrial Cleaners **512**
Complete details on G-E heavy-duty cleaning equipment. General Electric Co. Adv. page 120.

Iron Cement **513**
Free folder and repair handbook describes Smooth-On repairs. Smooth-On Mfg. Co. Adv. page 172.

COAL, ASH & BULK HANDLING

Airveyor **514**
Information on Fuller Airveyor pneumatic conveying system. Fuller Company. Adv. page 157.

Electric Vibrators **515**
Information on Syntron electric vibrators. Syntron Co. Adv. page 128.

COMPRESSORS

Compressors **516**
Free catalog contains complete information on Schramm stationary air compressors. Schramm, Inc. Adv. page 127.

Compressors, Motor Driven **517**
Bulletin 118 contains data on the complete Clark Balanced/Opposed, Motor-Driven line compressors. Clark Bros. Co., Inc. Adv. page 4.

CONTROLS, REGULATORS & INSTRUMENTS

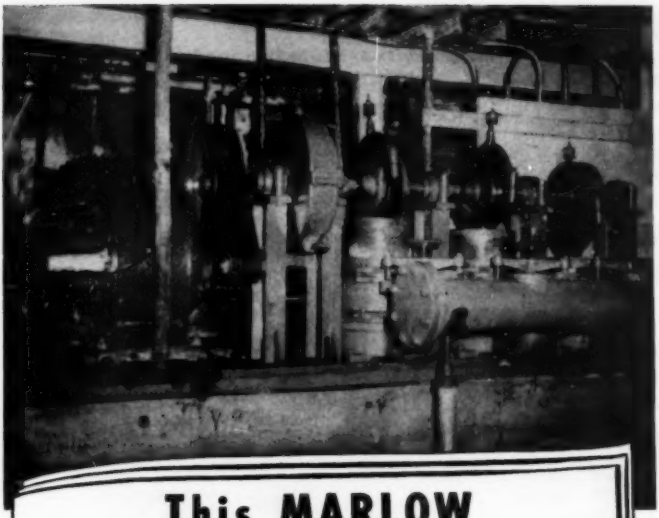
Regulators **518**
Bulletin 50-100 gives details on patented Stacon regulators. Farris Stacon Corp. Adv. page 172.

Temperature Control **519**
Bulletin 1200 gives complete details on entire line of automatic regulating valves, strainers and desuperheaters. Spence Engineering Co., Inc. Adv. page 155.

(Continued on page 134)

PRODUCT INDEX

Air & Dust Filters & Collectors 133
Anti-Corrosive & Protective Coatings 133
Boilers & Boiler Accessories 133
Building Heating, Ventilating, Air Conditioning & Refrigeration 133
Building Materials & Maintenance .. 133
Coal, Ash & Bulk Handling 133
Compressors 134
Controls, Regulators & Instruments ... 134
Diesels 134
Electrical Distribution 134
Electrical Heating Units 136
Fans & Blowers 136
Filters, Strainers & Purifiers 136
Fuels & Firing Equipment 136
Heat Exchanger Equipment 136
Instruments for Measure of Electricity . 138
Lubricants, Lubrication, Oil Filters & Purifiers 138
Materials of Construction 138
Mechanical Power Transmission 138
Packaged Steam Generators 141
Packing & Gaskets 142
Pipe & Fittings 142
Pumps 142
Refractories 144
Soot Blowers & Tube Cleaners 144
Steam Specialties 144
Thermal Insulation 146
Tools 146
Transformers 146
Turbines 146
Valves 146
Water Treatment 148

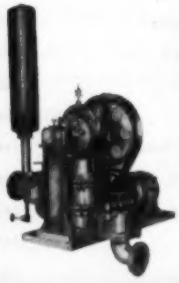


This MARLOW Plunger Sludge Pump Makes Paper "Flow" Smoothly

The Marlow Triplex above is moving semi-chemical neutral sulphite pulp from a stock chest to the beaters. The installation is at Watervliet Paper Co., Watervliet, Michigan.

Two other Marlow Plunger Sludge Pumps handle the long fibre pulp easily and steadily to keep the machine chests at required levels. One of these handles bleached sulphite from the bleach washer to a storage chest. The second pumps deinked and bleached waste paper from a bleach washer to a storage chest.

Marlow Plunger Sludge Pumps have a reputation for doing a beautiful job on bulky, thick, usually troublesome pumpage. They are consistently solving some of industry's most perplexing problems.



In your own industry, if you are concerned with heavy sluggish pumping of any kind, find out about the efficiency and durability of Marlow Plunger Sludge Pumps. And for your other pumping needs ask also about the famous Marlow Self-Priming Centrifugal Pumps — Portable and stationary models — and Marlow Portable Diaphragm Pumps.

Write today for name of dealer nearest you.

MARLOW PUMPS 515 GREENWOOD AVENUE RIDGEWOOD, NEW JERSEY

Manufacturers of the World's Finest Industrial Pumps

Readers' guide to advertised products

(Continued from page 133)

Gages **520**
8-page catalog describes Jerguson Truscale Gages. Jerguson Gage & Valve Company. Adv. page 149.

Thermometers **521**
Literature describes Weston all-metal, as well as electrical and glass thermometers. Weston Electrical Instrument Corp. Adv. page 171.

Thermometers **522**
Bulletin AA50 describes Weksler adjust-angle industrial thermometers. Catalogs available on other Weksler instruments. Weksler Thermometer Corp. Adv. page 173.

Feed Water Meters **523**
Information on Henszey feed water meters. Henszey Co. Adv. page 174.

Tank Gage **524**
Complete details on Liquidometer tank gage. The Liquidometer Corp. Adv. page 165.

Controls **525**
Catalog 700A contains complete data on Mercoid controls for automatic control of pressure, temperature, liquid level, mechanical operation, etc. Mercoid Corp. Adv. page 179.

DIESELS

Diesel Engines **526**
Complete information on Chicago Pneumatic Diesel Engine. Chicago Pneumatic Tool Co. Adv. page 145.

Diesels **527**
Facts and features available on gas engines, gas-diesels or full diesels. The Cooper-Bessemer Corp. Adv. page 41.

Diesels **528**
Information on Worthington heavy-duty diesels. Worthington Pump & Machinery Corp., Engine Div. Adv. page 153.

ELECTRICAL DISTRIBUTION

Circuit Breakers **529**
Complete literature on Heinemann circuit breakers. Heinemann Electric Company. Adv. page 108.

Unit Substations **530**
Complete information on I-T-E unit substations. I-T-E Circuit Breaker Co. Adv. pages 18, 19.

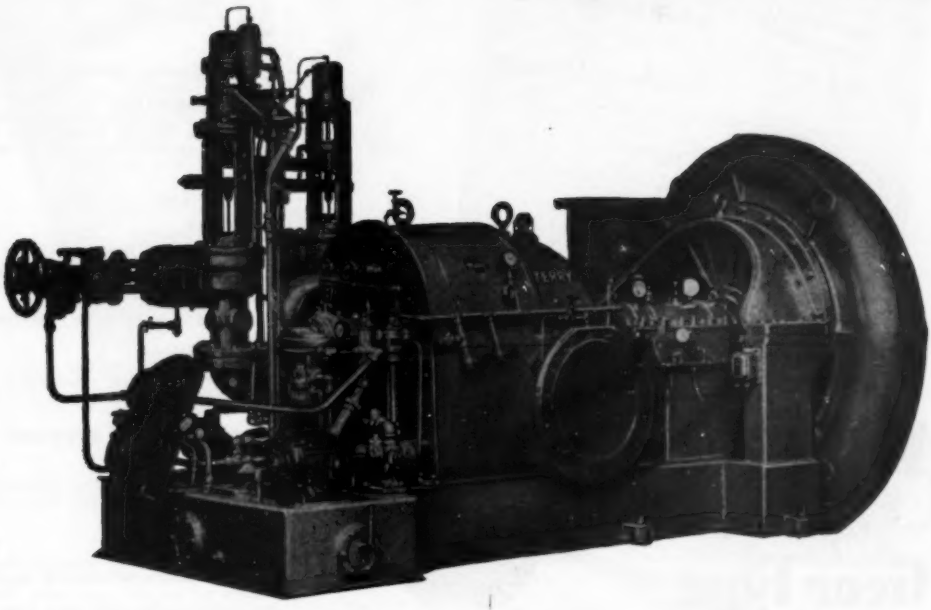
Deltabeston Cable **531**
Information on G-E Deltabeston

(Continued on page 136)

HOW TO REQUEST FREE LITERATURE

Insert "key" numbers on return post card found on page 131. For quick reference to free literature offered by advertisers in this issue, refer to listing on page 149. Our Reader's Service Department will handle your request promptly

The TERRY TURBINE



SPECIAL PURPOSE TURBINE

FOR OPERATION UNDER ALL THESE CONDITIONS:

1. Straight, high-pressure, condensing
2. Straight, low-pressure, condensing — putting to work excess low-pressure steam.
3. Mixed pressure — using the low-pressure steam available, with only enough high-pressure steam required to drive the compressor
4. Condensing bleeder operation — providing clean, low-pressure steam for heating or process work

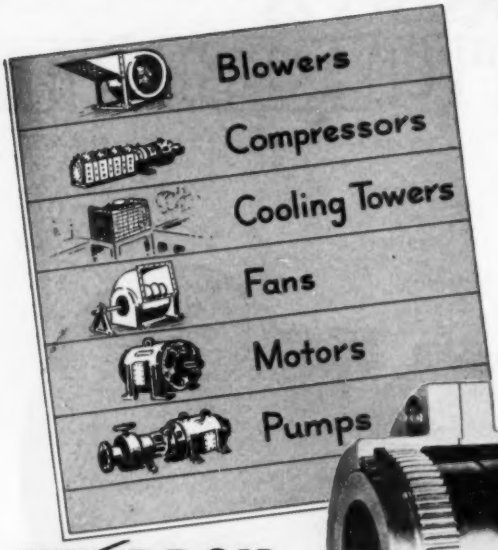
. . . and the speed under any of these conditions can be varied from 2800 to 4750 rpm.

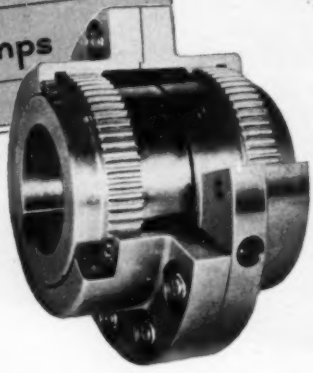
This is but one example of many unusual combinations developed by Terry to meet out-of-the-ordinary requirements in turbines up to 2000 hp. Information on a special-purpose turbine for your specific requirements will be gladly furnished.

T1177

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

FOR PROVEN COUPLING SERVICE ON



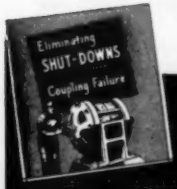


WALDRON Improved Gear Type

From every standpoint—design, construction, operating features—these WALDRON Couplings give greater assurance of longer, trouble-free service. No other coupling has so many major construction features for greater operating advantages. An examination of its many design refinements will quickly explain why the WALDRON coupling is so consistently specified for all types of applications where dependability of performance is a first essential.

Write for this Helpful Folder

explaining coupling features which give added insurance against coupling failure. No obligation.



JOHN WALDRON
CORPORATION
New Brunswick, New Jersey
Authorized Sales Representatives in Principal Cities

Readers' guide to advertised products

(Continued from page 134)

AVA cable. Construction Materials Div., General Electric Co. Adv. page 26.

ELECTRICAL HEATING UNITS

Electric Heaters **532**
Catalog 50 describes many types of Chromalox Electric Heaters and how to apply them. Edwin L. Wiegand Company. Adv. page 123.

FANS & BLOWERS

Fans and Blowers **533**
Adv. page 2 contains coupon for more information on Hartzell fans and blowers. Hartzell Propeller Fan Co.

FILTERS, STRAINERS & PURIFIERS

Air Line Filter **534**
Adv. page 163 contains coupon for information on Cuno Micro-Klean Air Line Filters. Cuno Engineering Corp.

FUELS & FIRING EQUIPMENT

Coal **535**
Adv. page 160 contains information on this product. General Coal Company.

Stokers **536**
Information on the complete line of Westinghouse underfeed and spreader stokers for use with any boiler. Westinghouse Electric Corp. Adv. page 63.

Burners **537**
Bulletin describes Enco Oil and Gas Burner Units in sizes to suit all capacity requirements. The Engineer Co. Adv. page 151.

LP-Gas **538**
Estimate on a Pritchard LP-gas standby plant engineered to your specific requirements. J. F. Pritchard & Co. Adv. page 162.

Coals **539**
Information on Bituminous Coal. Bituminous Coal Institute. Adv. pages 14, 15.

Stokers **540**
Catalog 505 gives engineering data on refuse burning installations. Detroit Stoker Co. Adv. page 125.

HEAT EXCHANGER EQUIPMENT

Cooling Towers **541**
Information on Fluor Cooling Tower Testing Facilities. The Fluor Corp. Adv. page 49.

Water Heaters **542**
Information on Pick instantaneous water heaters. Pick Mfg. Co. Adv. page 164.

Condensers **543**
Bulletin RC-1 contains data on Vogt horizontal and vertical types shell and

(Continued on page 138)

SEND FOR THE NEW P-K 40 PAGE WATER HEATER CATALOG

p-k catalog No. 202 provides you with a simple, rapid means of selecting the correct hot water heater for forced circulation.
Capacities from 95 to 101,000 gph.
Steam pressures range from 0 to 100 psig.
Standard "U" Tube Heaters are available in 2- 4- or 6-pass construction.
Water temperatures range from 40° to 100°F. inlet and 80° to 300°F. outlet.

1035

other TAB INDEX FEATURES

- Condensate Cooler tables
- Dishwater Booster Heater tables
- Gravity circulation tables
- Hot Water Service Heater tables
- Pressure drop tables
- Typical piping arrangement

the P-K please send p-k catalog 202

Patterson-Kelley Co., Inc.

133 BURSON ST., EAST STROUDSBURG, PENNA.

Name _____ Position _____

Company _____

Street _____ City _____ State _____

This 'dust' man can help you...

Solve Stack Dust Problems

He assures peak efficiency in Fly Ash Collection on boilers from 50 hp to 'the biggest yet'!

Most probably you know of the benefits you obtain from the recovery or collection of industrial escape-dust: new, higher efficiencies, a boost in employee morale, more favorable plant-community relations.

But—unless your dust collecting system is designed to the individual requirements of your plant, much of these potential benefits stand to go up the stack.

As a result, a Buell Engineer is a good man to know. Buell's staff of industrial 'dust' men draw on more than 200 man-years of experience in the design and construction of high-efficiency, trouble-free Dust Collection Systems. They can discuss the success of hundreds of Buell Installations, and how one can be designed for you.

For full information about the ***three basic systems*** of efficient Dust Collection and Dust Recovery write today. Ask for the new illustrated Buell 'Dust Recovery' bulletin. It can be a highly profitable move. Buell Engineering Company, Dept. 90-B, 70 Pine Street, New York 5, N. Y.

ELECTRIC CYCLONIC

HIGH EFFICIENCY CYCLONES • ELECTRIC PRECIPITATORS
TYPE 'LN' COLLECTORS • LOW DRAFT LOSS COLLECTORS
SPECIAL PURPOSE COLLECTORS • DUST HOPPER VALVES

buell

ENGINEERED EFFICIENCY IN DUST COLLECTION

Readers' guide to advertised products

(Continued from page 136)

tube condensers for every service. Henry Vogt Machine Co. Adv. page 167.

Water Heater **544**
P-K Catalog No. 202 describes Patterson-Kelley water heaters. Patterson-Kelley Co., Inc. Adv. page 137.

INSTRUMENTS FOR MEASURE OF ELECTRICITY

Hook-On Instruments **545**
Three hook-on instruments provide complete power-testing equipment. General Electric Co. Adv. page 143.

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

Colloidal Graphite **546**
"Dag" colloidal graphite (Bulletin No. 426-17B). Acheson Colloids Corp. Adv. page 111.

Lubricants **547**
Complete information on Stanolith Grease. Standard Oil Company (Indiana). Adv. page 64.

Lubricant **548**
Information on Sinclair Rubilene oil medium. Sinclair Refining Company. Adv. pages 30, 31.

Oil Purifiers **549**
Literature describes complete line of Hilco purifiers, filters, reclaimers and conditioners. The Hilliard Corp. Adv. page 140.

Lubricant **550**
Booklet IP-2 contains complete information on Sun Hydraulic Oils and recommendations to uses. Sun Oil Company. Adv. page 107.

Lubricant **551**
Free testing sample of N-No. 4 Grade Non-Fluid Oil and Bull. 522. New York & New Jersey Lubricant Co. Adv. page 158.

MATERIALS OF CONSTRUCTION

Incoloy **552**
Complete information on this wrought nickel-Chromium-Iron Alloy. The International Nickel Co., Inc. Adv. page 62.

MECHANICAL POWER TRANSMISSION

V-Belts **553**
Information on Goodrich Grommet

(Continued on page 141)

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Do you know how many jobs this vertical turbine pump can do?

We don't—but we'd like to! We've got an idea there are lots more than you might think.

Let's first take a look at the four inherent characteristics of vertical turbine pumps that make them the versatile units they are.

1. THE DRIVE UNIT IS REMOTE AND SEPARATE FROM PUMPING ELEMENT. The pump always operates submerged. No priming. No expensive dry pits, no suction or NPSH problems.

2. SPACE REQUIREMENTS AT A MINIMUM. Because of its vertical design, the vertical turbine pump takes less floor space than other types.

3. MECHANICAL AND HYDRAULIC FLEXIBILITY. Will operate with any type of drive. Discharge can be positioned to user requirements. Can be close coupled or several hundred feet long. Meets head and capacity requirements by varying the number of duplicate stages.

4. IT'S A SIMPLE MACHINE. Uni-directional thrust minimizes alignment problems. Easy maintenance, few moving parts, little friction, long life.

Have you thought of a vertical turbine pump for your application? We'd like to hear from you, send you full information on Worthington vertical turbine pumps—newest and broadest line of its kind, built by the *oldest* manufacturer of pumping equipment.

Worthington Pump and Machinery Corporation, Vertical Turbine Pump Division, Denver 16, Colo.; Succasunna, N. J.

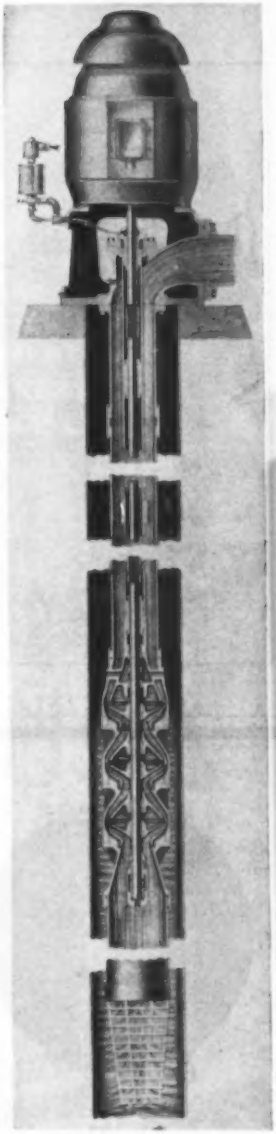
CHECK WORTHINGTON AGAINST THE REST

Only Worthington has all 8 vital design features as standard equipment.

The Ten Leading Makes Of Vertical Turbine Pumps
√ Indicates Feature Is Standard

Standard Features	Worthington	Pump A	Pump B	Pump C	Pump D	Pump E	Pump F	Pump G	Pump H	Pump I
Seals above and below drain ports (oil-lubricated model)	√									
Wearing rings	√				√			√		
Enclosed impellers	√	√	√	√	√	√		√	√	√
Bronze bushings in bowl assembly	√		√	√	√	√		√	√	√
Flanged and bolted bowls on all sizes	√						√		√	√
Sand collars at both ends of bowl assembly (water-lubricated model)	√	√								
Grease-packed bottom bearing	√	√			√					√
Choice of oil or water lubrication	√	√	√	√	√	√		√		

The reasons why Worthington Vertical Turbine Pumps are out in front of competition.



Typical section of the Worthington oil-lubricated vertical turbine pump that gives most efficient pumping performance at lowest possible cost.

D.I.10

The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON

Vertical Turbine Pumps

New Method of Artificial Respiration

Fig. 1

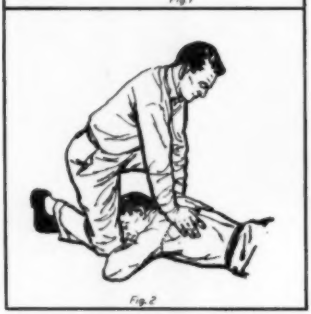


Fig. 2

An improved method of artificial respiration, known as the back-pressure arm-lift, has been adapted by the American National Red Cross, the armed services, several industrial firms, and other agencies and organizations. Used in several European countries for many years, this method permits greater exchanges of air and can be administered without undue fatigue.

The Red Cross is printing three million supplements on the new system for inclusion in its first aid and water safety textbooks. These supplements will be available without charge through Red Cross chapters.

In using this method the victim is placed face down in a prone position with arms overhead and bent at the elbows, one hand upon the other, and head turned to one side so that the cheek rests on the hands. The operator kneels on one knee at the victim's head and places his hands on the victim's back so that the thumbs just touch and the heels of the hands are just below a line running between the victim's armpits (Fig 1). He then rocks forward slowly, keeping the elbows straight until his arms are approximately vertical, exerting steady pressure upon the chest (Fig 2). Next he rocks backward, slowly sliding his hands to the victim's arms just above the elbows (Fig 3). Continuing to rock backward, he raises the arms until resistance and tension are felt at the victim's shoulder. He then drops the arms, thus completing a full cycle (Fig 4). The cycles are repeated 12 times per minute. Expansion and compression phases are of equal length, and release periods are of minimum duration.

Fig. 3

Fig. 4

OIL RECLAIMER

FILTER

HILCO LUBE and FUEL OIL PURIFICATION - - -

15 YEARS CONTINUOUS OPERATION WITHOUT OIL CHANGE IN DIESEL AND GAS ENGINES—NEGLIGIBLE PISTON AND CYLINDER WEAR.

THIS IS THE RESULT OF COMPLETE PURIFICATION—THE REMOVAL OF SLUDGE, CARBON, ACIDS, WATER, AND FUEL DILUTION.

HILCO UNITS IN OPERATION LONG ENOUGH TO PROVE THEIR VALUE. ONE-QUARTER CENTURY OF EXPERIENCE IS AT YOUR SERVICE.

- PURIFIERS
- FILTERS
- RECLAIMERS
- CONDITIONERS

THERE IS A HILCO FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM - - -

YOU WANT CLEAN OIL AND CLEAN ENGINES TO SAVE EQUIPMENT—OIL AND MONEY—INVESTIGATE HILCO OIL MAINTENANCE METHODS.

★ WRITE FOR FREE LITERATURE - - NO OBLIGATION

THE HILLIARD CORPORATION, 105 W. FOURTH STREET, ELMIRA, N. Y.

IN CANADA—UPTON-BRADEEN-JAMES, LTD., 990 BAY STREET, TORONTO. 3464 PARK AVE., MONTREAL

Readers' guide to advertised products

(Continued from page 138)

Belts. B. F. Goodrich Co. Adv. pages 53, 54, 55, 56.

Roller Bearings **554**
Catalog 547 contains complete data on Hyatt Hy-Load Light Series Roller Bearings. Hyatt Bearings Div., General Motors Corp. Adv. page 60.

V-Belts **555**
Information on Dayton Cog-Belts and Thorobred V-Belts. Dayton Rubber Co. Adv. page 17.

Belting **556**
Information on Republic's Challenger Transmission Belting. Republic Rubber Div., Lee Rubber & Tire Corp. Adv. page 42.

Couplings **557**
Folder contains information on Waldron improved gear type couplings. John Waldron Corp. Adv. page 136.

Steel Collars **558**
Descriptive literature on Hallowell solid steel collars. Hallowell Power Transmission Div., Standard Pressed Steel Co. Adv. page 173.

V-Belts **559**
Information on Goodyear steel cable V-belts. Goodyear Tire & Rubber Co. Adv. page 3.

Flexible Couplings **560**
Catalog with handy selector charts on Lovejoy flexible couplings. Lovejoy Flexible Coupling Co. Adv. page 150.

PACKAGED STEAM GENERATORS

Steam Generators **561**
Literature describes Continental Packaged Steam Generators. Boiler Engineering & Supply Co. Adv. page 20.

Generators **562**
Bulletin EC-100G describes Dutton Econotherm packaged steam generators. Dutton Boiler Div., Hapman-Dutton Co. Adv. page 117.

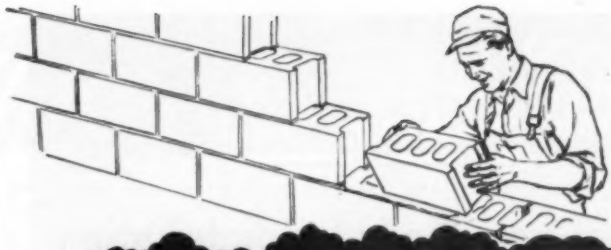
Generator **563**
Bulletin No. 1218 contains complete details on the Powermaster steam generator. Orr & Sembower, Inc. Adv. page 29.

Generators **564**
Catalog contains information on Clayton Forced Recirculation Generators. Clayton Mfg. Co. Adv. page 129.

Steam Generators **565**
Catalog 402 contains complete information on Superior packaged steam generators. Superior Combustion Industries Inc. Adv. page 130.

Generators **566**
Bulletin 1000 contains complete data on Preferred Unit Steam Generators.

(Continued on page 142)



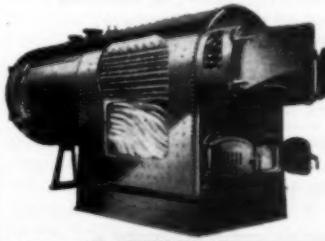
HIGH PRESSURE STEAM
CURES CEMENT BLOCKS
IN 54 TON AUTOCLAVES . . .
AT HARTER MARBLECRETE

KEWANEE
HEAVY-DUTY BOILER

• In the modern plant of Harter Marblecrete Stone Co., at Oklahoma City, cement blocks are cured with high-pressure steam at 135 to 150 psi in five of the *largest autoclaves ever built.* (Pictured above)

A further interesting fact about this outstanding development is the use of a 26-inch vacuum, pulled with an Elliott barometric condenser, for the drying stage.

High pressure steam is provided by a gas fired 300 hp Kewanee Boiler producing 10,500 pounds of steam per hour.



Cut-a-way View of KEWANEE "500" used in Harter Marblecrete Plant. Sizes for 40 to 304 hp . . . 100-150 psi.

FOR HEATING, POWER AND INDUSTRIAL PROCESS STEAM

Wherever steam is needed . . . high or low pressure . . . there is a Kewanee Boiler just right. Ask for complete catalogs and information.

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS
Eastern District Office: 40 West 40th Street, New York City 18
Division of American Radiator & Standard Sanitary Corporation

Heating America's Finest Buildings

Serving home and industry

KEWANEE BOILERS

new Snap-on* Catalog
OF INDUSTRIAL WRENCHES AND MECHANICS TOOLS
now ready for distribution
*Snap-on is the trademark of Snap-on Tools Corporation
Snap-on
"THE CHOICE OF BETTER MECHANICS"
SNAP-ON TOOLS CORPORATION KENOSHA, WISCONSIN
Send for your copy TODAY!

This complete and well-illustrated catalog describes Snap-on's entire line of standard wrench equipment and mechanic-type maintenance tools. The most complete line of its kind! Write today for your copy and discover why Snap-on is servicing businesses everywhere with tools for more efficient production, maintenance, and service.

- 42 Factory Branches to assure prompt shipment!
- Facilities for production runs of special tools available!
- Widest range available from any one source!

SNAP-ON TOOLS CORPORATION
8102-B 28th Avenue
Kenosha, Wisconsin

Readers' guide to advertised products

(Continued from page 141)

Preferred Utilities Mfg. Corp. Adv. page 112.

PACKINGS AND GASKETS

Packings and Gaskets **567**
Catalog describes R/M packings and gaskets. Raybestos-Manhattan, Inc., Packing Div. Adv. page 48.

Pumcups **568**
Bulletins 4401 and 4502 contain data on Darcova Pumcups for reciprocating pumps, for air or hydraulic mechanisms. Darling Valve & Mfg. Co. Adv. page 161.

Packings **569**
Bulletin 4291P contains complete information on Durametallic Flexible Metallic Packing. Durametallic Corp. Adv. page 148.

Packings **570**
Information on packings and gaskets. Quaker Rubber Corp., Div. of H. K. Porter Co., Inc. Adv. page 119.

PIPE AND FITTINGS

Pipe Fabricating **571**
Complete information on any industrial requirement in piping. Albert Pipe Supply Co. Adv. page 175.

Flexible Metal Hose **572**
Bulletins SS-50 and CC-300 contain full details on American flexible metal hose and tubing. The American Brass Co., American Metal Hose Branch. Adv. page 52.

Flexible Metallic Tubing **573**
Illustrated folder "Flexineering" contains data on Penflex tubing. Pennsylvania Flexible Metallic Tubing Co., Inc. Adv. page 59.

Flexible Metal Hose **574**
Complete information on products manufactured by Flexonics Corporation, formerly Chicago Metal Hose Corp. Adv. page 65.

Pipe Unions **575**
Adv. page 144 contains information on Dart Unions. Dart Union Company.

Piping **576**
Information on Grinnell pipe hangers and supports for every piping requirement. Grinnell Co., Inc. Adv. page 47.

PUMPS

Pumps **577**
Information on Marlow plunger sludge pumps. Marlow Pumps. Adv. page 134.

Pumps **578**
Bulletin No. B-1605 describes features of Peerless Type PR pumps. Peerless Pump Div., Food Machinery

(Continued on page 144)

TESTING TIPS

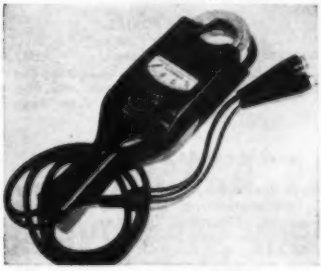
for the maintenance of plant equipment

AK-1 VOLT-AMMETER

Ranges 0-15/60/150/600 volts
0-150/600 amperes

Accuracy ±3% full scale

***PRICE $74.75**

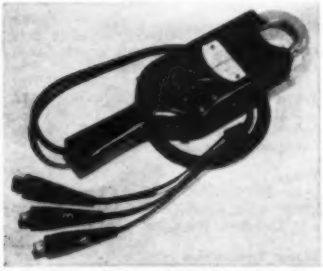


AK-2 WATTMETER

Ranges 0-3, -6, -20, -60, -200, -300 kw
15-600 amperes, 100-600 volts

Accuracy ±3% full scale

***PRICE $84.75**



AK-3 POWER-FACTOR METER

Ranges 100-600 volts, 15-600 amperes

Scales A: 0.5-0-0.05 lag-lead
B: 1.0-0.5 lead
C: 0.5-1.0 lag

Accuracy 0-0.05 power factor

***PRICE $84.75**

**Manufacturer's suggested retail price*

Cleveland Company Saves More Than $500; Cuts Testing Time 50% with G-E Hook-ons

Three Hook-on Instruments Provide Complete Power-testing Equipment

The Motor Repair and Manufacturing Co. of Cleveland, Ohio, finds the General Electric team of three hook-on instruments to be the answer to their electrical maintenance problems. Mr. Carol Levison, President of Motor Repair and Manufacturing Co., reports, "I previously spent over $500 for testing equipment which I have now discarded since the purchase of these three instruments."

REPLACES SIX INSTRUMENTS

"My hook-on power-factor meter alone does the job previously done by using a wattmeter, two current transformers, two ammeters and a voltmeter," says Mr. Levison. "Time that was formerly lost in computing the results of readings is now being put to better use." Construction of these hook-on instruments permits easy handling and quick analysis of any electrical problem.

Designed to fill almost all of the needs in electrical maintenance checks, General Electric hook-on instruments measure volts, amperes, reactive current, power, and power factor.

Used for motor checks and unbalanced loading checks of polyphase circuits, the AK-1 volt-ammeter is lightweight and accurate—3% full scale.

The AK-2 wattmeter is a handy portable instrument for measuring a-c power quickly and easily. Both single and polyphase circuits can be analyzed by the AK-2; in addition to kilowatts, it will measure vars in balanced three-phase circuits.

If your power factor is now	you can release this much extra capacity	with this many capacitors for each 100 kw of load
65%	34%	84 kvar
70%	29%	69 kvar
75%	23%	55 kvar
80%	17%	42 kvar
85%	11%	29 kvar
90%	5%	15 kvar

(Power factor is raised to 95%. New load is at original power factor.)

Accurate to within 0-0.05 PF, the AK-3 power-factor meter may be used on any balanced 3-phase circuit. It reads power factor directly in the circuit. When making capacitor surveys, you'll find the AK-3 a valuable time saver. The table above shows what you can expect from adding capacitors to your feeder lines.

BUY NOW FROM
STOCK
At Your Nearest
G-E Distributor

GENERAL ELECTRIC

GEI-2211

What's a 4-Letter Word for LONG LIFE?

D-A-R-T ...YOU CAN USE ONE Over and Over Again!

This True Ball Joint Makes the Difference

Darts last longer and hence cut your maintenance costs for three reasons:

1. **NON-CORROSIVE BRONZE SEATS**
Both seats are made of non-corrosive bronze for maximum protection against pitting and corrosion.

2. **PRACTICALLY INDESTRUCTIBLE NUT AND ENDS**
The nut of a Dart and both ends are constructed of high test, air refined malleable iron. You get peak resistance to stress, stretching and wrenching.

3. **DROP-TIGHT WITHOUT EXCESSIVE WRENCHING**
Even though a Dart can *take* heavy wrenching, you don't have to *give* it! Because it's precision ground to a perfect sphere, the true ball joint gives a snug, drop-tight fit easily, quickly. It *stays* tight, too.

In repeated use, longer life, easier installing—Darts give you MORE for your union money!

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston New York Pittsburgh

DART UNIONS

Readers' guide to advertised products

(Continued from page 142)

& Chemical Corp. Adv. page 33.

Controlled Volume Pumps **579**
Additional information on Milton Roy controlled volume pumps for boiler water treatment. Milton Roy Co. Adv. page 34.

Pumps **580**
Information on Weinman centrifugal pumps. The Weinman Pump Mfg. Co. Adv. page 122.

Pumps **581**
Information on Worthington vertical turbine pumps. Worthington Pump & Machy. Corp., Vertical Turbine Pump Div. Adv. page 139.

Pumps **582**
Condensed Catalog "M" contains information on Aurora pumps. Aurora Pump Co. Adv. page 178.

REFRACTORIES

Refractories & Insulations **583**
Catalog describes the complete line of R&I refractories and insulations. Refractory & Insulation Corp. Adv. page 38.

SOOT BLOWERS & TUBE CLEANERS

Soot Blowers **584**
Information on Diamond G9B soot blowers. Diamond Power Specialty Corp. Adv. page 58.

Tube Cleaners **585**
Bulletin gives complete details on Wilson TP-301 high speed tube cleaner. Thomas C. Wilson, Inc. Adv. page 168.

STEAM SPECIALTIES

Air Vents **586**
Bulletin 2751 contains complete data on Sarco thermostatic air vents. Sarco Company, Inc. Adv. page 40.

Traps **587**
Yarway Impulse Steam Traps (free offer of trial trap). Yarnall-Waring Company. Adv. page 66.

Traps **588**
Book "Solving Steam Trap Problems" with details. The V. D. Anderson Co. Adv. page 182.

Steam Specialties **589**
Bulletins contain complete information on Illinois steam specialties. Illinois Engineering Co. Adv. page 179.

(Continued on page 146)

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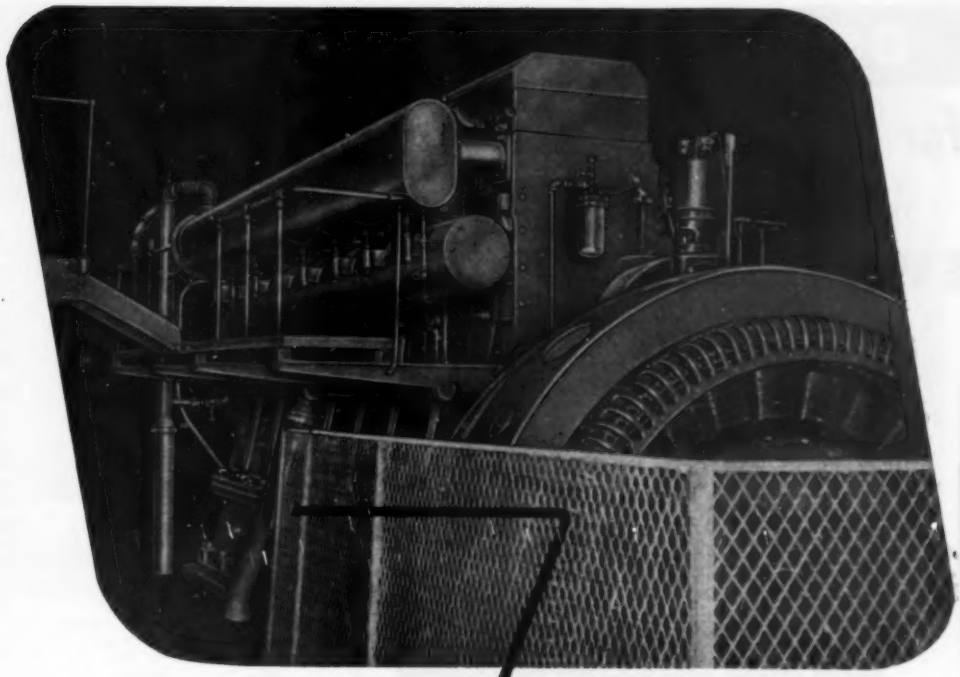


1500 H. P. Elliott Turbocharged CP Diesel installed in a midwestern utility plant.

CHICAGO PNEUMATIC heavy duty, medium and slow speed DIESEL ENGINES

Whatever may be your horsepower requirements, there is a Chicago Pneumatic Diesel engine that will meet your needs. Available in sizes ranging from 120 H.P. to 1750 H.P., these engines can be furnished either for straight Diesel or for Dual Fuel operation.

The CP engine line includes both normally aspirated and supercharged engines. All supercharged engines incorporate the thoroughly dependable Elliott Turbocharger.

Years of reliable performance and low cost power have won for Chicago Pneumatic an outstanding position in the Diesel field.

CP Diesels have proved profitable investments for public utilities, industrial, municipal, ice and water-works plants, and in mining, oil, pipeline, cotton ginning and other fields where low cost, dependable power is a vital necessity.

Write for complete information

CHICAGO PNEUMATIC TOOL COMPANY

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

DOUBLE SAFETY

for your BOILER BLOW-OFF

with this EVERLASTING DUPLEX UNIT

There's *doubly-safe* boiler blow-off action in this EVERLASTING Duplex Unit.

The STRAIGHT-THROUGH TYPE on the left gives you wide-open, full-pipeline flow with a quarter turn of the lever. It's designed so that no damaging grit can lodge between the seat and the sealing disc . . . and the more the valve is used, the more the self-lapping action of the disc rotating across the seat *improves* the drop-tight seal.

The ANGLE TYPE on the right is stoutly built to withstand the blow-off shock. It takes the punishment, all right . . . *and endures.* Abrasives can't hurt this valve, either, because there are no pockets where they can lodge.

Thus, this EVERLASTING Valve team assures practically *zero maintenance* as well as *double safety.* Conforms to ASME and other codes . . . made in sizes 1½-in., 2-in and 2½-in for pressures up to 600 psig . . . and either valve available separately in cast iron or steel. Write today for full information without obligation.

EVERLASTING VALVE CO., 49 FISK STREET, JERSEY CITY 5, N. J.

Everlasting Valves

Trade Mark "EVERLASTING" Reg. U.S. Pat. Off.

EV 819A

for everlasting protection

Readers' guide to advertised products

(Continued from page 144)

THERMAL INSULATION

Aluminum Jacketing **590**
Free sample and complete information on Childers aluminum weatherproof jacketing. Childers Mfg. Co. Adv. page 50.

Heat Insulation **591**
Complete details on Kaylo heat insulation. Owens Illinois Glass Co. Kaylo Division. Adv. page 25.

TOOLS

Snap-On Tools **592**
New Snap-on catalog of industrial wrenches and mechanics tools. Snap-on Tools Corp. Adv. page 142.

Tube Rolling Control **593**
Descriptive literature on Airetool Tube Rolling Control. Airetool Mfg. Co. Adv. page 154.

Blower Suction Cleaner **594**
Clements-Cadillac portable blower-suction cleaner. 5 Models with attachments. Clements Mfg. Co. Adv. page 165.

TRANSFORMERS

Transformers **595**
Information on Stockwell distribution and power transformers. Stockwell Transformer Corp. Adv. page 126.

TURBINES

Turbines **596**
Type E Turbines (Book B-3896). Westinghouse Electric Corp. Adv. page 43.

Turbines **597**
Information on Worthington compressor drive steam turbines. Worthington Pump & Machinery Corp. Steam Turbine Div. Adv. page 57.

Turbines **598**
Information on Terry special purpose steam turbines. The Terry Steam Turbine Co. Adv. page 135.

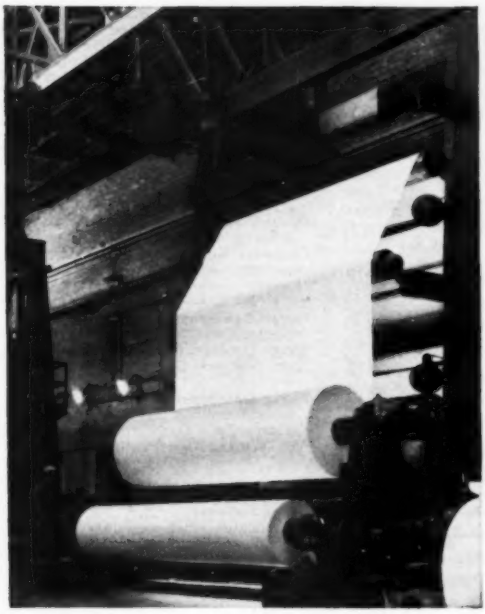
VALVES

Valves **599**
36-page Catalog No. V-52 gives full details on all Hills-McCanna valves. Hills-McCanna Co. Adv. page 156.

Valves **600**
Information on Powers Flowrite and Metaflow valves. The Powers Regulator Co. Adv. page 61.

Blow-Off Valves **601**
Bulletins B-425 and B-433 contain complete information on Yarway seatless blow-off valves. Yarnall-Waring Co. Adv. pages 44, 45.

(Continued on page 148)



Mill . . . Office . . . Assembly . . . Laboratory . . . Tannery

Trane Air Conditioning Serves Everywhere in Industry

If you have a heating or air conditioning problem in your plant, turn to the complete Trane line of heating and air conditioning equipment for a satisfactory answer.

In Mills—In a midwest paper mill, a forest of towering machinery blocked air circulation and prevented even heating. Trane Projection Unit Heaters equipped with Louver Cone Diffusers solved the problem economically by putting the heat right down where it was needed.

In Offices—Oft-opened doors can be a gathering place for fuel consuming drafts. An eastern chemical works has placed a Trane Force-Flo Heater on each side of the entrance to its attractive new administration offices to eliminate drafts at their source, and save fuel.

On Assembly Lines—With conveyors operating on several levels, overhead cranes in other parts of the plant, and the general factory area broken up into smaller areas, heating was a difficult problem. A midwest range manufacturer solved it by placing Trane Projection Unit Heaters with Louver Cone Diffusers thirty feet above the floor. Immediately, gentle heat is delivered to workers far below in the coldest weather.

In Laboratories—The laboratory of a large eastern manufacturer required plenty of filtered, tempered, fresh air to facilitate the testing of materials. Trane Unit Ventilators were installed under the windows to bring in fresh outdoor air and warm it to the desired degree, for a pleasant working atmosphere.

In Tanneries—Adequate control of temperature, volume of air, and humidity is important in the drying of hides. This tannery installed Trane Model H Horizontal Unit Heaters at floor level in its drying room. Warm air rises between the hides and the drying is uniform.

Whether it's mills, offices, assembly lines, laboratories, or tanneries, Trane heating and air conditioning serves everywhere in industry.

Whatever your heating, cooling, ventilating or air conditioning problem is, look for the answer in the complete Trane line.

On Assembly Lines—Trane Projection Unit Heaters with Louver Cone Diffusers at the ceiling keep workers warm.

In Laboratories—Trane Unit Ventilators provide plenty of fresh outdoor air for a comfortable working atmosphere.

In Tanneries—Drying hides is but one of the hundreds of applications of the Trane Horizontal Unit Heater.

TRANE

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division . . . Scranton, Pa.
Trane Company of Canada, Ltd., Toronto

OFFICES IN 80 U. S. AND 14 CANADIAN CITIES

Readers' guide to advertised products

(Continued from page 146)

Valves **602**
Catalog 68-J describes the complete line of Strong steam specialties. Strong, Carlisle & Hammond Co. Adv. page 166.

Valves **603**
Illustrated Catalog No. 10 contains information on Chapman List 960 Forged Steel Gate Valves. The Chapman Valve Mfg. Co. Adv. page 159.

Valves **604**
Full information on Everlasting Duplex Unit for doubly-safe boiler blow-off action. Everlasting Valve Co. Adv. page 146.

Pressure Regulator Valve **605**
Information on No. 960 Crane pressure regulator valve. Crane Co. Adv. page 7.

Valves **606**
Catalog and "The Valve News" describe Rockwell Valves. W. S. Rockwell Co. Adv. page 170.

Valves **607**
Catalog gives 4 ways to cut pump repairs. Sims Pump Valve Co., Inc. Adv. page 152.

Multiport Valves **608**
Information on H&T poppet-type multiport valves. Hungerford & Terry, Inc. Adv. page 165.

WATER TREATMENT

Water Treatment **609**
Free bulletin "Experimental Studies of Boiler Scale at 2,500 psi." National Aluminate Corp. Adv. page 9.

Water Treatment **610**
Illustrated Drew Organics Folder describes use of organics in modern boiler water treatment. E. F. Drew & Co., Inc. Adv. page 121.

Water Conditioning **611**
Bulletin No. 124 contains complete information on Betz water conditioning service. W. H. & L. D. Betz. Adv. page 13.

Water Treating Equipment **612**
Bulletin 1845 contains complete information on JBAS water treating equipment. Infilco Inc. Adv. page 51.

HOW TO REQUEST FREE LITERATURE

Insert "key" numbers on return post card found on page 131. For quick reference to free literature offered by advertisers in this issue, refer to listing on page 149. Our Reader's Service Department will handle your request promptly

Boiler Water Comparator **613**
Free data book "Modern pH and Chlorine Control" contains data on Taylor boiler water comparators. W. A. Taylor and Co. Adv. page 6.

Automatic Control **614**
Information on automatic control of processes for removal of water impurities. Belco Industrial Equipment Div. Adv. page 122.

Organic Sludge Dispersive **615**
Bulletin 28X7543 describes Allis-Chalmers No. 26 Series organic sludge treatment. Allis-Chalmers. Adv. page 21.

Water Conditioning **616**
Coupon will bring new catalog on Elgin Double-Check zeolite softener. Elgin Softener Corp. Adv. page 115.

Water Conditioning **617**
Information on Worthington's Hot-Z Slurry-Type Deaerating Water Softener. Worthington Pump & Machinery Corp., Water Treating Div. Adv. page 46.

Water Softener **618**
Publication 4520 describes Cochrane sodium zeolite softener & hydromatic single control valve, Pub. 4530 describes hyrogen zeolite softeners. Cochrane Corp. Adv. page 180.

Water Treatment **619**
Information on Dearborn engineered equipment for your water treatment. Dearborn Chemical Co. Adv. page 169.

DURAMETALLIC

Packings

SAVE DOLLARS

"THE PACKING THAT IS ENGINEERED FOR THE JOB"

The bearing-like sealing provided by Durametallic Flexible Metallic Packing means minimum wear on rods, shafts and sleeves! Genuine maintenance savings for you in repair, replacement and shutdown costs. . . . .

"Always Specify DURAMETALLIC"

WRITE FOR DURAMETALLIC PACKING BULLETIN NO. 429 IP

The PERFECT SEAL

DURAMETALLIC CORPORATION
KALAMAZOO MICHIGAN

MANUFACTURERS OF METALLIC and SEMI-METALLIC PACKINGS
ROTARY MECHANICAL SEALS and PACKING TOOLS

WANTED
MECHANICAL ENGINEER

Engineers wanted for research and development work on dust collectors, fly ash precipitators, scrubbers and other types of air cleaning devices. Experience and interest in this type of work is desirable. Excellent opportunities. Employer is well established, progressive and expanding manufacturer. Seventy (70) years in Detroit area with plants in central states and on west coast. Modern plant facilities and offices, excellent working conditions and steady employment.

Write giving full details—

Box 2-A
INDUSTRY AND POWER
St. Joseph, Mich.

QUICK REFERENCE TO BULLETINS AND CATALOGS OFFERED BY ADVERTISERS IN THIS ISSUE

Following is an alphabetical listing of those advertisers offering free literature in their advertisements. To obtain your copies, all you need do is to list the "Key Numbers" for literature desired on the yellow postal card on page 131

Advertiser	Page No.	Catalog	Key No.
Acheson Colloids Corp.	111	Colloidal Graphite	546
Airetool Mfg. Co.	154	Tube Rolling Control	593
Allis-Chalmers	21	Organic Sludge Dispersive	615
American Brass Co., The American Metal Hose Branch	52	Flexible Metal Hose and Tubing	572
Anderson Co., The V. D.	182	Solving Steam Trap Problems	588
Aurora Pump Co.	178	Pumps	582
Betz, W. H. & L. D.	13	Return Line Corrosion	611
Boiler Engineering and Supply Co.	20	Continental Packaged Steam Generator	561
Buell Engineering Co.	138	Dust Recovery	501
Chapman Valve Mfg. Co., The	159	Forged Steel Gate Valves	603
Chicago Pneumatic Tool Co.	145	Diesel Engines	526
Clark Bros. Co., Inc.	4	Motor Driven Compressors	517
Clayton Mfg. Co.	129	Forced Recirculation Steam Generators	564
Cochrane Corp.	180	Water Softeners	618
Coppus Engineering Corp.	27	Blowers and Ventilators	509
Cuno Engineering Corp.	163	Micro-Kleen Air Line Filters	534
Darling Valve & Mfg. Co.	161	Darcova Pumcups	568
Dearborn Chemical Co.	169	Water Treatment	619
Detroit Stoker Co.	125	Refuse Burning Installations	540
Drew & Co., Inc., E. F.	121	Drew Organics	610
Durametallic Corp.	148	Flexible Metallic Packing	569
Elgin Softener Corp.	115	Water Conditioning	616
Engineer Co., The	151	Oil & Gas Burner Units	537
Everlasting Valve Co.	146	Blow-Off Valves	604
Farris Stacon Corp.	172	Temperature Regulators	518
General Electric Co.	120	Heavy Duty Vacuum Cleaner	512
General Motors Corp., Hyatt Bearings Div.	60	Radial Roller Bearings Guide	554
Hapman-Dutton Co., Dutton Boiler Div.	117	Econotherm Steam Generators	562
Hartzell Propeller Fan Co.	2	Fans	533
Henszey Company	174	Feed Water Meters	523
Hilliard Corp., The	140	Lube and Fuel Oil Purification	549
Hills-McCanna Co.	156	Valves	599
Illinois Engineering Co.	179	Steam Specialties	589
Infilco Inc.	51	JBAS Water Treating Equipment	612
Jerguson Gage & Valve Company	149	Truscale Gages	520
Kaylo Division, Owens-Illinois Glass Co.	25	Heat Insulation	591
Kewanee Boiler Corp.	141	Heavy-Duty Boilers	507
Liquidometer Corp., The	165	Tank Gauge	524
Lovejoy Flexible Coupling Co.	150	Flexible Couplings	560
Mercoid Corp., The	179	Mercury Switch Controls	525
National Aluminate Corp.	9	"Experimental Studies of Boiler Scale at 2,500 psi"	609
New York & New Jersey Lubricant Co.	158	Non-Fluid Oil	551
Orr & Sembower, Inc.	29	Powermaster Steam Generator	563
Patterson-Kelley Co., Inc.	137	Water Heaters	544
Peerless Pump Division	33	Pumps	578
Pennsylvania Flexible Metallic Tubing Co.	59	"Flexineering"	573
Pick Mfg. Co.	164	Instantaneous Water Heaters	542
Preferred Utilities Mfg. Corp.	112	Unit Steam Generators	566
Raybestos-Manhattan, Inc.	48	R/M Packings and Gaskets	567
Refractory & Insulation Corp.	38	R & I Refractories and Insulations	583
Rockwell Co., W. S.	170	Butterfly Valves	606
Rust-Oleum Corp.	35	Stops Rust	502
Sarco Company, Inc.	40	Thermostatic Air Vents	586
Schramm, Inc.	127	Stationary Air Compressors	516
Sims Pump Valve Co., Inc.	152	Pump Valves	607
Smooth-On Mfg. Co.	172	Repair Handbook	513
Snap-On Tools Corp.	142	Industrial Wrenches & Maintenance Tools	592
Spence Engineering Co., Inc.	155	Temperature Regulators	519
Standard Pressed Steel Co.	173	Solid Steel Collars	558
Stockwell Tranformer Corp.	126	Transformers	595
Strong, Carlisle & Hammond Co.	166	Steam Specialties	602
Sun Oil Co.	107	Hydraulic Oils	550
Superior Combustion Industries, Inc.	130	Packaged Steam Generators	565
Taylor and Co., W. A.	6	Modern pH and Chlorine Control	613
Vogt Machine Co., Henry	167	Condensers	543
Waldron Corp., John	136	Gear Type Couplings	557
Weksler Thermometer Corp.	173	Adjust-Angle Industrial Thermometers	522
Westinghouse Electric Corp.	43	Type E Steam Turbines	596
Weston Electrical Instrument Corp.	171	Thermometers	521
Wickes Boiler Co., The	181	Steam Generators	506
Wiegand Co., Edwin L.	123	Electric Heaters	532
Wilson, Inc., Thomas C.	168	Tube Cleaners	585
Worthington Pump & Machinery Corp. Vertical Turbine Pump Div.	139	Vertical Turbine Pumps	581
Steam Turbine Div.	57	Steam Turbines	597
Yarnall-Waring Company	44, 45	Blow-Off Valves	601

Get Truscale For Accurate Liquid Level Indication Down Where You Can See It

Get This New Catalog of JERGUSON TRUSCALE REMOTE READING GAGES

JERGUSON Truscale Gages are virtually indispensable protection for boilers, storage tanks and processing equipment. A single error in reading liquid level can prove very expensive. Jerguson Truscale Gages forestall errors by bringing the reading down to eye level where your operator can see it and properly protect your equipment.

Amazingly accurate, the Jerguson Truscale Gage records liquid level at remote points with accuracy as close as ½ of 1% of scale reading; has built-in adjustment for easy calibration for any specific gravity or W.S.P.; has standard ranges up to 100"; internal moving parts of stainless steel; visible and audible alarm systems; illuminated dial; scale markings and pointer that glow in the dark; and is available with auxiliary repeaters.

The new Jerguson catalog, profusely illustrated, tells in compact, easy-to-read form how Jerguson Truscale Gages operate . . . and why they are the best and the most dependable for your remote reading needs.

Send now for your copy of the new 8-page Jerguson Truscale Gage catalog. Write today.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Representatives in Major Cities
Phone Listed Under JERGUSON
In Europe: Bailey Meters & Controls, Ltd.

New equipment and developments

(Continued from page 20)

is made up in two packaged sets. One set is 80 ft long, 440 w, 115 v; the other is 160 ft, 800 w, 230 v. Each has a 170 ft cold lead section and plug. Thermostatic control is an optional feature.

19—Compound sets anchor bolts

The Hallemite Mfg. Co. announces Por-Rok Quick Setting Cement for setting anchor bolts in concrete. It successfully replaces lead and sulphur for most bolt-setting operations. Applied cold, there is no heating hazard. It is necessary only to drill hole, set bolt in place, mix Por-Rok with water, and pour into opening around bolt

Within 15 to 30 min the bolt is anchored permanently. The material is self-bonding, self-leveling, oil-resistant, will not shrink, and has a compression strength of 4500 psi.

20—Transformers made for test room use

To aid in obtaining the high degree accuracy necessary in testing electronic equipment, Acme Electric Corp. announces the development of a shielded isolating transformer, which it is claimed provides a voltage supply source independent of any line interference or disturbance on the primary side. A test room having this unit as its source of electrical supply is entirely independent of primary line interferences. Test room lighting, soldering irons, tinning pots, electrical hand tools, clocks and instruments may all be operated from the shielded secondary supply. The secondary winding of the transformer is completely enclosed in a copper electrostatic shield. Metallic shielded secondary cables are integrally attached to the copper shield. This shield is usually connected to the shielding of the test room, which is then connected to ground. This places the shielded transformer secondary in the same electrostatic compartment with the interior of the test room. The line includes ratings from ½ to 15 kva, 120 or 240 v primary, 120 v secondary.

21—Coatings aid refractories

Preferred Utilities Mfg. Corp. offers two coating materials to prolong the life of refractories, metal, ceramics and glass exposed to extreme temperatures. It is claimed that these coatings expand and contract like the materials to which they are applied and will not peel, blister, bloat or check even under rapid temperature changes. Reflection of some of the heat aids in obtaining operating temperatures more rapidly. White Hot withstands temperatures to 2840 F and Pyro-Chrome to 4000 F.

TO REQUEST ADDITIONAL FREE DATA

Each paragraph in this section is numbered —beginning with number 1. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out and mail this card. Our Reader Service Department will handle your request promptly

22—Radiant heat units are portable

An important feature of radiant heat — the ability to cut through cold air and warm anything in its path—has, in many cases, solved the problem of keeping men warm in hard to heat locations both indoors and out. Edwin L. Wiegand Co. has announced

three models of Chromalox electric radiant heaters which can readily be adapted to many locations. They can be bolted beside machines, mounted on portable rigs or simply laid on the floor to warm workers' legs. Lengths of the three models are 24½, 30¾ and 46¾ in. They are 800, 1100 and 1800 w respectively, and the first two can be obtained in 115 or 230 v, while the latter is

(Continued on page 152)

withstands 50% higher speeds

the NEW LOVEJOY FLEXIBLE COUPLING

Increases in speed up to 50% are handled with complete safety by this new Lovejoy Flexible Coupling. The secret is a special multiple leaf spring that holds the collar in place. As with all Lovejoy Couplings, the new model instantly adjusts for misalignment, vibration, surge or backlash. Half of the cushions are idlers — except on reversing load — so a new set is always in the coupling. Shutdowns are eliminated, since load cushions are quickly interchanged without tearing down coupling. Quiet operation with no lubrication ever needed. Lovejoy Couplings are for services from 1/6 to 2,500 H.P.

Write for catalog with handy selector charts

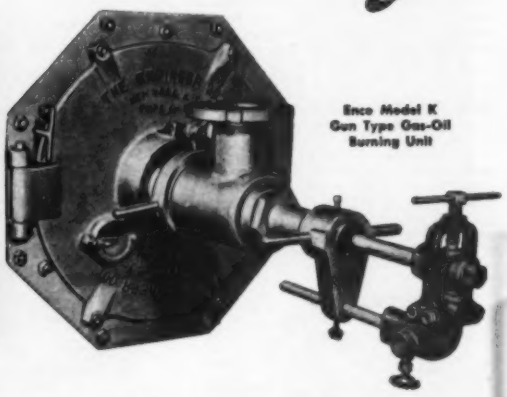
LOVEJOY FLEXIBLE COUPLING CO.

5043 W. LAKE STREET CHICAGO 44, ILLINOIS

Also Mfrs. of Lovejoy Universal Joints and Lovejoy Variable Speed Transmissions

flexible... 3 ways

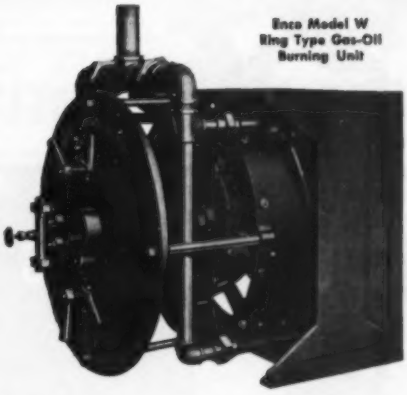
ENCO
OIL AND GAS BURNER UNITS



Enco Model K
Gun Type Gas-Oil
Burning Unit

These specially designed oil and gas burner units fit your needs . . . even when your operating conditions keep changing. Enco Oil and Gas Burner Units offer money-saving flexibility on three important counts. (1) They are designed for use with either oil or gas — or both . (2) They assure completely uniform combustion and greater fuel economy though steam demands swing sharply. (3) They can be operated by either natural or forced draft.

Even if your old combustion equipment "works", it pays to investigate the fuel-saving economies and full flexibility of these highly efficient units. Enco Burner Units are made in many sizes to suit all capacity requirements. Bulletin on request.



Enco Model W
Ring Type Gas-Oil
Burning Unit

ENCO
INTERCHANGEABLE ATOMIZERS
FOR USE WITH ALL TYPES OF BURNER EQUIPMENT

Wide Range Mechanical—Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

Steam or Air—Wide range. Controlled by manual or automatic pressure regulation.

Standard Range Mechanical — Available in all sizes to suit load and capacity requirements.

Enco Standard Range Mechanical Atomizer Gun
Enco Wide Range Steam Atomizer Gun
Enco Wide Range Mechanical Atomizer Gun
Enco Standard Atomizer Gun Support
Enco Gas Burning Gun

EC-483

THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: F. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34 P.Q.

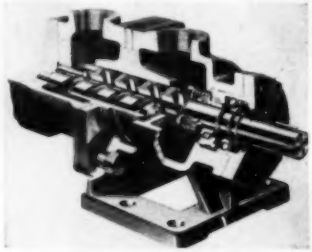
New equipment and developments

(Continued from page 150)

for 230 v only. Standard units are equipped with BX cable and plug and two movable mounting clamps and bolts. Protective grills and input controllers for selective heating are available.

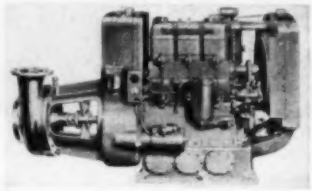
23—Rotary pump for high pressures

De Laval-IMO A313B pump, designed to handle a wide variety of oil handling applications for pressures up to 275 psi, has been announced by De Laval Steam Turbine Co. This rotary positive displacement pump offers all the features of the IMO design. It has only three moving parts and is quiet, pulsation-free, compact and excellent for high speed operation. It can be used for capacities to 80 gpm, pressures to 275 psi and intermittent pressures up to 325 psi. This pump handles light or viscous fluids in hydraulic systems, rotary and steam atomizing oil burners, lubrication, governing systems and similar devices.



24—Diesel unit offers three variations

Addition of a three-cylinder Diesel engine, rated at 30 to 45 hp within a speed range of 1200 to 1800 rpm, is announced by Nordberg Mfg. Co. This engine, known as the 4FS3, has a 4½ in. bore and 5¼ in. stroke and is a four-cycle, vertical, mechanical injection Diesel engine. Built as a complete self-contained, ready to operate unit, it is available as an electric generator



set, pumping unit or with clutch or stub shaft power take-off for direct connection or belt drive. The generator set is completely equipped and is delivered ready to connect. It is available in d-c or a-c models from 20 to 30 kw in all standard voltages, 50 or 60 cycle. Built with side suction ball bearing pumps, the pumping unit has a capacity of 500 to 3000 gpm at 20 to 220 ft head. Engines with direct or clutch power drives are readily adaptable for replacement engines in many types of equipment. The engine is designed to start and operate on regular Diesel fuels. Electric starting equipment includes a starting motor and a battery charging generator. The 4FS3 is built for stationary applications with a radiator type cooling system.

25—Rust preventative dries in ten minutes

Rust Inhibitor No. FD-425 is announced by United Laboratories, Inc. Outstanding features of this rust preventative paint are that it will dry in ten minutes under normal drying conditions, and one coat provides excellent hiding of the old metal surface. It will withstand temperatures from minus 100 F to plus 250 F, and is exceptionally resistant to salt air and fumes. It may be applied over damp surfaces, interior or exterior, galvanized metal and new or rusted metal surfaces of all kinds. The process leaves an attractive semi-gloss finish, and is available in several colors plus aluminum and clear.

TO REQUEST ADDITIONAL FREE DATA

Each paragraph in this section is numbered —beginning with number 1. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out and mail this card. Our Reader Service Department will handle your request promptly

26—Switchgear features interchangeable parts

A standard line of metal-clad switchgear, ranging in ratings from 2400 to 15,800 v, 150 to 500 mva, has been announced by the General Electric Co. The line offers many improved design features, although it retains the same general arrangement of major components, and all industry standards have been retained. One design improvement is in the magne-blast circuit breaker, in which a maximum number of parts are interchangeable among breakers of different ratings. Another feature is an electromechanical control device, built integrally into the breaker mechanism. An improved insulating material having excellent flame-retardant, dielectric and anti-hygroscopic properties is used throughout the breaker.

(Continued on page 154)

4 WAYS TO CUT THOSE PUMP REPAIRS

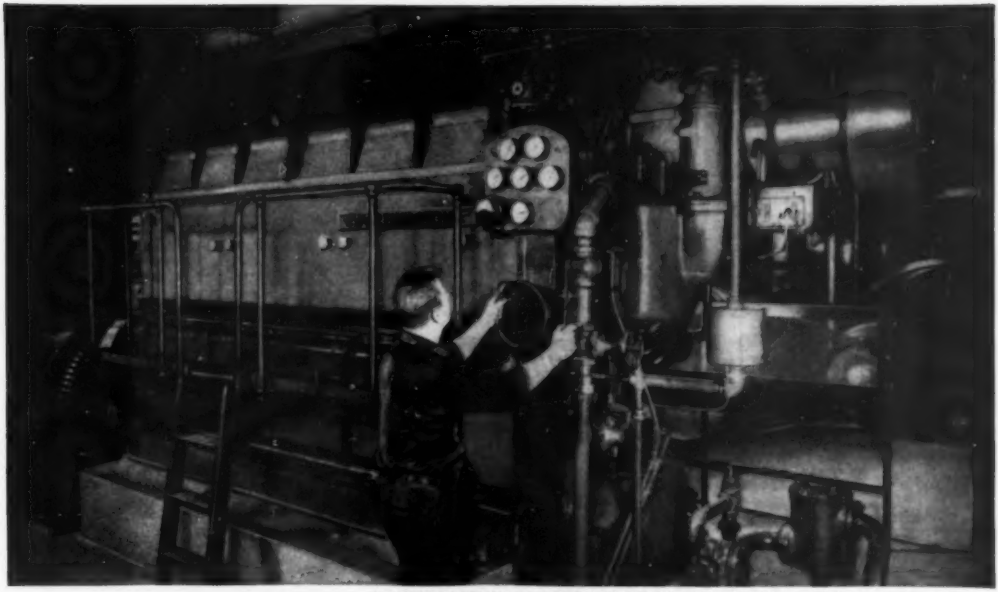
Sims valves are made in sizes from 2¾" to 15¼" to fit any reciprocating pump. Valves supplied ready to install—cast in individual units or in complete plates.

1. **Prevent STEM and SPRING breakage.** Exclusive double shock absorber built into Sims valves stops impact shock.
2. **Stop wear.** Long guide of ROTATOR prevents cocking of DISC—assures even opening.
3. **Keep seating surfaces leak free.** Only Sims guarantees the valve DISC will rotate every time it lifts.
4. **Stop valve slam and knock.** Quiet operation is gained by cushioning moving parts and cutting resistance to flow through the SEAT ... with patented inclined ribs. This reduction of resistance allows cylinders to fill completely. Pump capacity is increased 20%.

SIMS PUMP VALVE CO., INC.

New catalog shows how Sims valves fit any pump—how they work—efficiency and comparison charts. Send for your free copy today.

145 HUDSON ST., NEW YORK 13, N. Y. • M & M BLDG., HOUSTON, TEXAS



WORTHINGTON SUPERCHARGED DIESEL ENGINE at Kalamazoo Paper Co., Kalamazoo, Michigan, driving 600-kw generator.

Kalamazoo Paper Co. guards against costly shutdowns with heavy-duty diesel generator

Company installs Worthington supercharged diesel and 600-kw generator for stand-by

An insurance policy against costly shutdowns! Such is the attitude of Kalamazoo Paper Company management towards the Worthington medium-speed, heavy-duty diesel they've installed for stand-by service.

Reason for their choice of this large heavy-duty unit was the reputation for absolute dependability that has been built up for these rugged Worthington engines over a period of years.

Let's look at some of the time-tested features that insure this dependability:

1. *Heavy cast-iron base and frame.*
2. *Steel forged crankshaft bedded in base.*
3. *Gear-driven camshaft.*
4. *Metal-to-metal fit between cylinder heads and liners.*
5. *Main bearings lubricated at bottom where pressure is greatest.*
6. *4-bolt connecting-rod bearing assembly.*

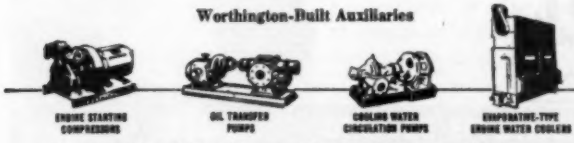
An insurance policy can be no better than the company that backs it. That's why before you buy, it will pay you to look carefully into the manufacturer's reputation.

It is by serving customers such as Kalamazoo that Worthington through the years has built a reputation for manufacturing long-lived, dependable equipment—a reputation that is backed in the heavy diesel field by the *longest experience* of any manufacturer of this type of equipment.

Feel free to call on Worthington for further details on diesel performance. We can meet all your engine requirements—oil, gas, or "dual fuel". Contact Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.

E.I.4.

Worthington-Built Auxiliaries



Economical Continuous Power—Diesel Engines, 150 to 2,640 hp . . . Gas Engines, 190 to 2,880 hp . . . Dual Fuel Engines, 150 to 2,640 hp.

WORTHINGTON
Engines

breaks all records

for FAST

ACCURATE

TUBE ROLLING

. . . THE AIRETOOL TUBE ROLLING CONTROL

It's amazing that any tool which rolls tubes with such uncanny accuracy can do it with such speed. Yet, it's a fact that wherever the AIRETOOL tube rolling control has been tested against ordinary tube rolling methods, new performance records have been set. Tube bundles can now be perfectly rolled in half the time formerly required.

This increased speed and accuracy is quickly translated into greater production . . . less downtime . . . easier work. Before you tackle your next tube rolling job, study the performance record of the AIRETOOL Tube Rolling Control. Write for descriptive literature to The AIRETOOL Mfg. Co., 318 S. Center St., Springfield, Ohio.

here's how it operates

An AIRETOOL ball-bearing type expander is inserted into the tube to be rolled. A powerful motor drives the expander and when the desired degree of expansion has been reached, the control instantaneously cuts off the power. This is accomplished by setting a dial calibrated for the tube size and type to be rolled. The expander is then removed and inserted into the next tube to be rolled. Unfailing mechanical control replaces human judgment and fast, perfect tube rolling is assured.

There's an AIRETOOL Tube Cleaner and Tube Expander for every type of Tubular Construction

AIRETOOL

MANUFACTURING COMPANY

SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Philadelphia, Chicago, Houston, Tulsa, Baton Rouge

New equipment and developments

(Continued from page 152)

Equipment framework is of completely welded construction. All breaker elevating mechanisms are driven by a motor, which is demountable for hand crank operation, and is controlled by a safety interlocked control system. Downward movement of the breaker from vibration is prevented by an anti-creep device.

27—Continuity tester needs no live wires

A pocket-size continuity tester is being added to the line of electricians' tools manufactured by Ideal Industries, Inc. This tester is designed to determine continuity of circuits and identify wires between ter-

minals or in multi-wire cable, as in switchboards and control panels. It permits testing of circuits without the need of live wire connections, as it provides its own power from pen-lite batteries, and uses a signal light indicator which illuminates the point of contact. It requires only one hand, and is no larger than a pen-lite flashlight. Testers come equipped with a four-foot cord and alligator clip. When not in use the test lead is detached, eliminating any chance of exhausting the batteries.

TO REQUEST ADDITIONAL FREE DATA

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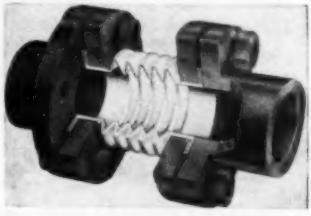
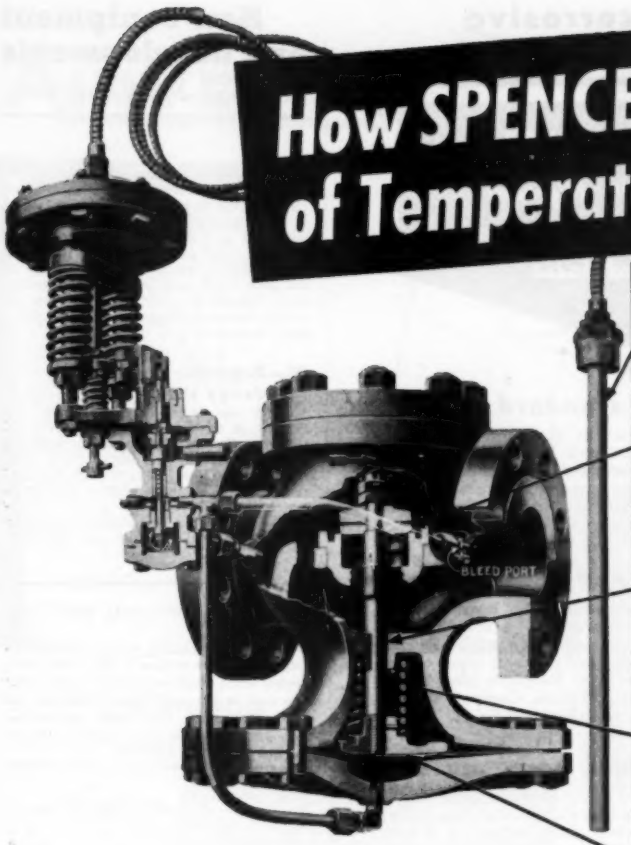
28—Bellows connector dampens vibration

Fabricated by Crane Packing Co. of chemically inert Teflon, the "John Crane" bellows type connector has many pipe line applications where vibration, expansion and electrolysis exist in the handling of



(Continued on page 156)

How SPENCE Cuts Costs of Temperature Control



NEW THERMOSTAT ELEMENT—Improved to practically eliminate loss of filling. Rugged construction; cannot be injured by overheating.

SECO METAL—Seats and discs are made of SECO Metal—guaranteed not to wire-draw.

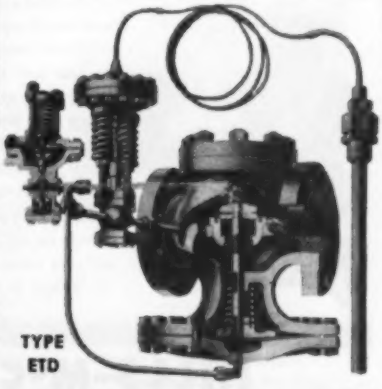
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

PROTECTED SPRINGS — Springs in the Spence Regulator are out of the path of the steam or other fluid flowing through the valve.

LARGE BALANCED DIAPHRAGM— Spence metal diaphragms, under usual conditions, never require replacement.

Accurate Control for Both Storage and Instantaneous Heaters

Spence Temperature Regulators reduce the steam pressure and also accurately modulate the flow as required to control the temperature. No separate reducing valve is necessary • The Spence ET150 Regulator is recommended for heater pressures up to 50 psi. For higher pressures the Type ETD is available • For complete details on the entire Spence line of automatic regulating valves, strainers and desuperheaters, write for Bulletin 1200.



TYPE ETD

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

for valving corrosive and "hard-to-handle" fluids . . .

HILLS-McCANNA

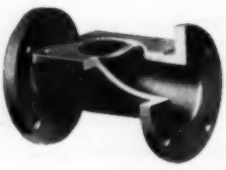
offers over 20,000 different "custom-made" assemblies on a standardized basis

32 standard operators

Methods of operation for Hills-McCanna Valves include handwheel and lever operators, sliding stem, air and hydraulic cylinders, diaphragm motors and electric motors in a variety of types.

14 standard diaphragms

Diaphragms, the heart of Hills-McCanna Valves, are offered in the widest choice to best suit your individual needs; 5 types of rubber, 3 of Neoprene plus Hycar, butyl, Tygon, Compar, special polyethylene and Kel-F.



48 standard body materials

Bodies for Hills-McCanna valves are furnished in cast iron, with or without such linings as rubber, glass, lead, etc.; in any machinable alloy or in such materials as Karbate, stoneware, porcelain, etc.

By offering such a broad selection of operators, diaphragms and bodies, Hills-McCanna is able to furnish so many standard combinations that the user is in the position of being able, in most cases, to find the exact valve that best fits his individual requirements. There is virtually never any need to adapt to your service a valve developed for someone else's needs.

The 36 page catalog No. V-52 gives full details on all Hills-McCanna Valves. Write for your copy. HILLS-McCANNA CO., 2355 W. Nelson St., Chicago 18, Illinois.

HILLS-McCANNA

saunders patent diaphragm valves

Also Manufacturers of Proportioning Pumps

Force Feed Lubricators • Magnesium Alloy Castings

New equipment and developments

(Continued from page 154)

corrosive liquids or gases and solvents. The connector is electrically non-conductive, flexible even at minus 94 F and as strong at 480 F as at 70 F. It serves as a vibration dampener as well as an expansion joint, connects misaligned couplings and insulates flanges electrically. End flanges of the joint are French-type envelope gaskets made integral with the joints for easy assembly between companion flanges and a tight, leak-proof seal on installation.

29—Regulator features design simplicity

Quick disassembly for relapping and cleaning in the field is featured in the design of self-operated temperature regulator manufactured by Farris Stacon Corp. The regulator, designated as Type 1005, has visual fingertip dial control, built-in strainers to protect the pilot and main valves, stainless steel seats and discs, and internal porting to eliminate external damage and minimize

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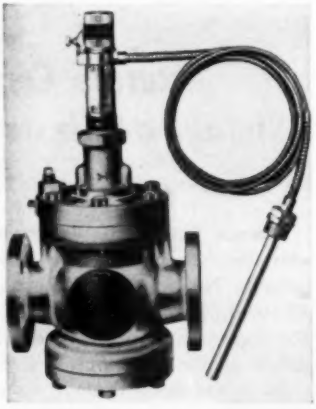
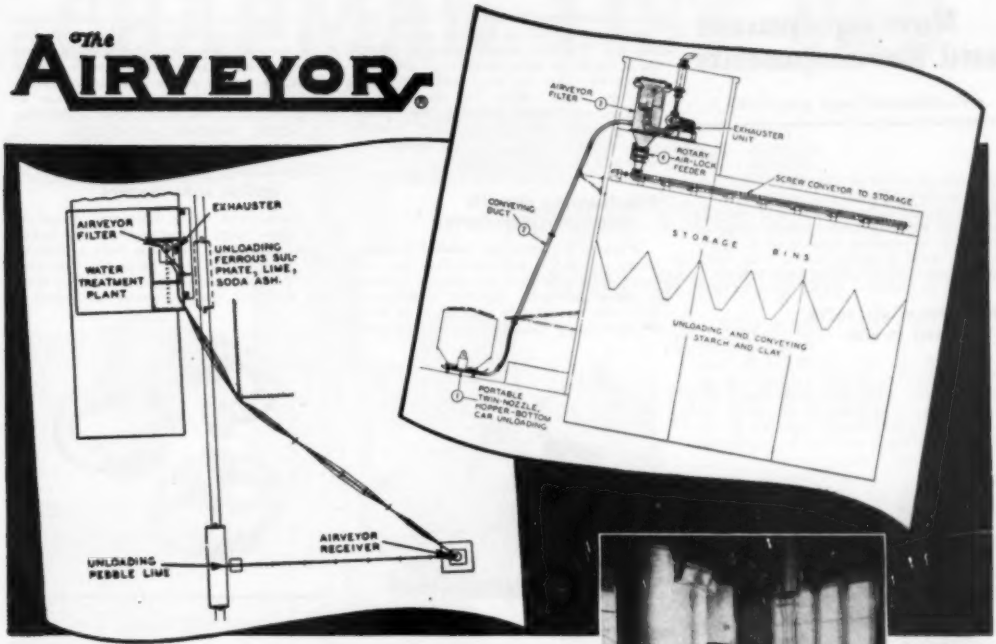
maintenance. Control accuracy of plus or minus 1 deg F, obtained by means of a fully balanced, single-seated pilot operating on a vapor flash principle is claimed by the manufacturer. Ninety-nine per cent of



the power to position the valve is taken directly from the steam, and only one per cent from vapor expansion in the thermostatic system. The regulator is self-contained

(Continued on page 158)

The AIRVEYOR®



Pre-planning means a more efficient installation

. . . always START FROM SCRATCH

When you handle dry pulverized and granular materials, the sensible, economical, and most satisfactory plan of selecting a pneumatic conveying system is to "Start from scratch" . . . make your selection while the plant is still in the planning stage. Pneumatic conveyors permit economy and convenience in location of buildings and production equipment without the restrictions or straight-line limitations of mechanical conveyors.

Fuller Engineers have years of experience in their field. They'll survey your plans, make a close study of local conditions and the materials to be handled. Then—they'll make their recommendation from one of the four Fuller time-and service-proved systems, at no obligation to you.

And—because each installation has peculiar requirements of its own—their recommendation will be the right one for the job—the system that will handle your materials in the most efficient and economical way. Shown here is the Airveyor, used successfully for unloading dry pulverized, crushed, granular materials from shipping units, and for conveying to and from storage. It is economical, safe, thoroughly dependable.

Fuller has specialized in pneumatic conveying systems and knows from experience that the most successful, the most economical, and the most trouble-free installations are engineered and built along with the plant, with individual requirements in mind. Call on Fuller when planning a new plant or modernizing an old one; you'll be sure of a conveying system that meets your requirements in every detail.

FULLER COMPANY, Catasauqua, Pa.
Chicago 3—120 So. LaSalle St.
San Francisco 4—420 Chancery Bldg.

Fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS — COMPRESSORS AND VACUUM PUMPS — FEEDERS, AND ASSOCIATED EQUIPMENT

A-129

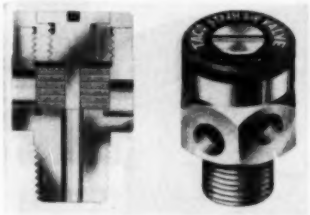
New equipment and developments

(Continued from page 156)

and pilot operated in sizes from 2 through 4 in. It is available with 125 or 250 lb ASA flanges for steam pressures from 10 to 150 psig, and for temperature control from 30 to 325 F. Adjustment range is 60 F. Eight feet of capillary tubing and a 1 in. NPT connection on the bulb are included.

30—Steam air valve small in size

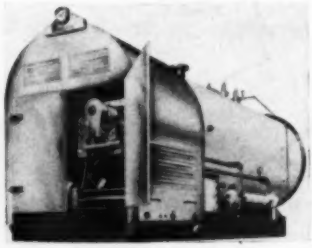
A steam air valve introduced by Taco Heaters, Inc., is claimed to work on an entirely new principle. Measuring only ¾ x 1 in., it is quiet in operation, has no floats, can be manually operated if necessary, vents freely and can be installed in



any position except upside down. In operation, air is forced out between special composition discs by steam pressure. When steam enters the valve, moisture in the steam causes the discs to swell and completely seal the valve. After the thermostat is satisfied and steam subsides, the system may go into vacuum for a few minutes after which the discs dry and shrink and are ready for another cycle.

31—Housing permits outdoor installation

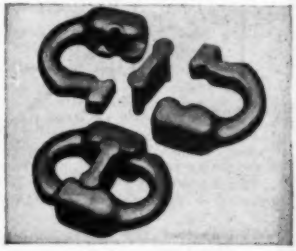
While most boilers are installed in boiler rooms completely protected from the elements, such housing is not entirely essential to their operation. Superior Combustion Industries, Inc. reports that many of their Superior Steam Generators have done tem-



porary outdoor duty while boiler rooms were under construction or renovation. More recently, a number of generators have been built especially for outdoor installation. To cover the vital working parts, a special housing has been designed. While providing the required protection, this housing makes all working parts readily accessible. Safety features include power lockouts to prevent operation with the doors closed when an engineer is in the enclosure. Construction is simple, watertight, and effective.

32—Chain links permit quick, safe repairs

Introduction of a Universal design in Wedglok safety connecting links for carbon and alloy chain users has been announced by the Interstate Drop Forge Co. The links are stronger than alloy steel chain of comparable size. Only two sizes are needed to



connect any size chain from ¼ to ¾ in., depending upon the type of chain used. These links permit users to make up chain slings safely and quickly from running lengths of chain. Other Wedglok links are available in sizes up to 3 in. They are used in material handling, chain operations in steel mills, foundries, industrial plants, oil fields, strip mining, logging and on construction work.

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33—Unit supplies emergency lighting

The Sentry-Lite Div. of Hobby & Brown Electronic Corp. announces the advent of their Sentry-Lite Model 200X, a fully

(Continued on page 160)

NON-FLUID OIL

TRADE MARK REGISTERED

N-#4 Grade Specially Designed For Pressure Lubrication

N-#4 Grade of NON-FLUID OIL is a distinct improvement over ordinary greases because it does not "disintegrate" even when subjected to the highest pressures per square inch.

N-#4 Grade will not thin out under heat, or harden at low temperatures, retaining its normal oiliness and full lubricating power under all service conditions . . . instead of becoming dry or gummy, as is usually the case with so-called "pressure lubricants".

Write for free testing sample of N-#4 Grade NON-FLUID OIL and Bulletin No. 522.

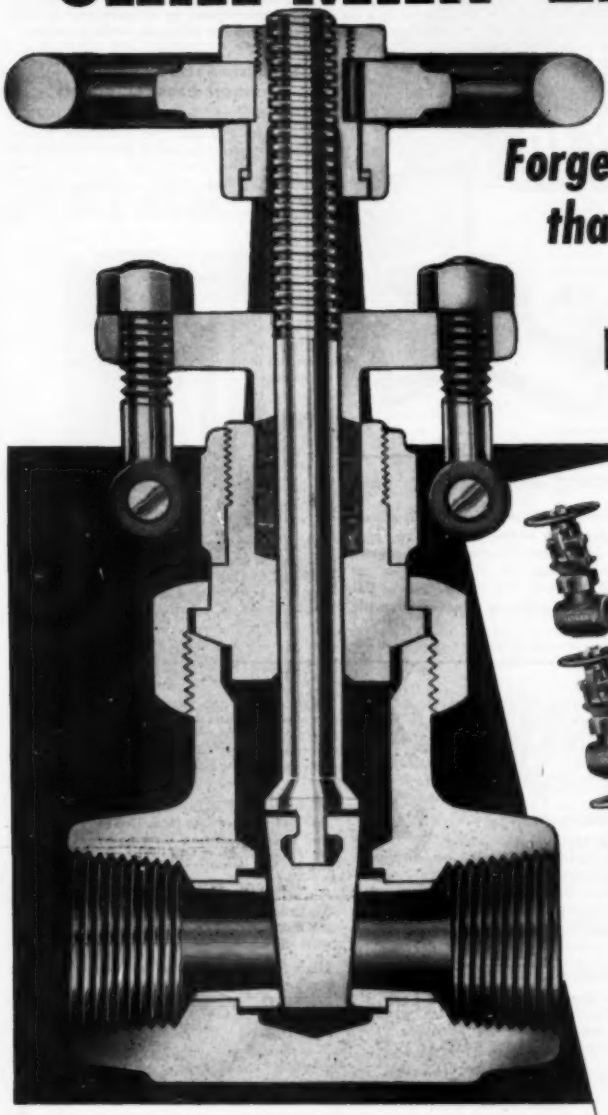
NEW YORK & NEW JERSEY LUBRICANT COMPANY

292 MADISON AVENUE, NEW YORK 17, N. Y.—WORKS: NEWARK, N. J.

WAREHOUSES: Atlanta, Ga.; Birmingham, Ala.; Charlotte, N. C.; Chicago, Ill.; Columbus, Ga.; Detroit, Mich.; Greensboro, N. C.; Greenville, S. C.; Providence, R. I.; St. Louis, Mo. Also represented in most other industrial centers, including Cleveland, Ohio; Cincinnati, Ohio; Pittsburgh, Pa.; Syracuse, N. Y.

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

CHAPMAN LIST 960



the one Forged Steel Gate Valve that gives you this 4-WAY PROTECTION

Extra Protection Against Even Unusual Stress is provided by extra-strong stem-and-wedge-gate connection.

Repairs and Replacements Are Reduced by super-hardened seat rings and gate faces of stainless steel.

Longer-Lived Body and Yoke are of forged steel. And bolted follower has no threads on yoke to corrode.

No Seizing or Galling of Gate Faces because List 960's gates (when furnished with certain types of trim) are hardened by *Malcomizing* (patented Chapman process) to a minimum of 800 Brinnell.

An exceptionally wide range of services is covered by this small forged steel gate valve . . . giving you the same consistent top level performance on many different jobs.

Chapman List 960 Forged Steel Gate Valves are manufactured in sizes from ¼" to 2" inclusive, and in these 2 types: (1) Rising stem with yoke (shown), and (2) Rising stem with inside screw. Bonnet joints are either gasketed or metal-to-metal. Pressure range: 2000 lb. at 100°F. — 380 lb. at 1000°F. For higher pressures, specify List 990. Send for illustrated Catalog No. 10.

THE CHAPMAN VALVE MFG. CO., INDIAN ORCHARD, MASS.

New equipment and developments

(Continued from page 158)

automatic and independent emergency lighting unit. The unit plugs in an ordinary outlet and functions automatically when power fails, illuminating 10,000 sq ft for a period of nine hours or more. When power is reestablished, it immediately starts to recharge automatically. The unit is produced in a compact, easily portable steel case with two adjustable sealed beam lamps providing illumination. A Thomas A. Edison battery provides power. Also incorporated are test lights and switch, and a charger light and switch.

34—*Universal pH meter very accurate*

Philips Universal pH Meter, precision built for reliable service and for quick accurate measurements of hydrogen-ion concentrations, is now available from the Research & Control Instruments Div., North American Philips Co., Inc. The instrument is designed for all pH and rH work, for potentiometric titrations and for oxidation-reduction-potential investigations. For laboratory research and industrial testing purposes, it provides a measuring accuracy of 0.01 pH or 0.5 mv, a range of 0-14.15 pH and 0-1415 mv, absolutely currentless measuring with no phenomena of polarization, zero indication by cathode ray tube, can be used with glass, quinhydrone, hydrogen and platina electrodes and is direct calibrated for the first three. Unit has a built-in Philips cadmium standard cell and a flexible cable with a plug for connection to a 60 c power supply circuit. Transformer taps can be changed to accommodate voltages of 110, 125, 145, 200, 220 and 245. The meter is enclosed in a wood cabinet, as is an auxiliary chemical set available as an accessory. Complete assembly of two units is designed for precise measurements of

millivoltage and hydrogen-ion concentration. In the latter, it can help control completeness of precipitation, coagulation, flocculation, rate of settling, adsorption, crystallization, speed or completeness of reaction, speed of filtration, and corrosion.

35—*Distributors handle circuit breaker panels*

BullDog Electric Products Co. is now featuring its P2B and P3B Pushmatic Electri-Center (circuit breaker) panelboards under a new merchandising program, which makes lighting panels available for immediate delivery from the distributor's shelves. Previously panels had to be ordered

from the factory, which meant a lengthy delay. Now, by stocking the basic devices, the distributor can meet customer specifications and provide a complete panel. A basic device consists of cabinet, front and an interior.

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RODA — High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

DEMDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK — The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE — Roda and Stonega from Wise County, Va.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL — High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER — Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO — High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

GENERAL — REG. U.S. PAT. OFF.

ANTHRACITE
Hazel Brook—*Premium Lehigh*
Raven Run—*Premium Mahanoy*
Cross Creek—*First Grade Lehigh*

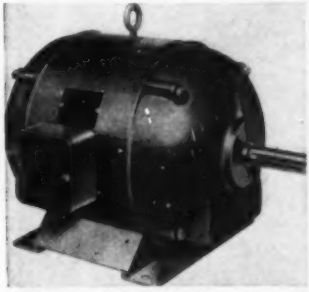
Our engineering service, available upon application, and long and varied experience is your assurance of the Right Coal — Properly Applied.

General Coal Company
123 SOUTH BROAD STREET PHILADELPHIA 9, PA.
CABLE ADDRESS, GENCO
Branches:
BLUEFIELD, W. VA. BUFFALO CHARLOTTE, N. C. CINCINNATI
NEW YORK NORFOLK PITTSBURGH

The customer merely informs the counterman whether he needs 3 wire single phase or 4 wire three phase, flush or surface type front, and number and type of individual circuit breakers. The counterman then makes up the desired panel from the component parts. Only five panelboards are necessary to cover hundreds of applications. The panels are available up to 42 circuits and are Underwriters approved. Individual thermal magnetic breaker units, rated 15, 20, 30, 40 and 50 a, are quickly mounted and fully interchangeable.

36—Motor ratings to 125 hp available

Industrial Motor Div. of Robbins & Myers, Inc., announces the addition of four frame sizes, expanding its line of standard motors to include 125 hp ratings. The four sizes are designed for all-weather operation, with special treatment to resist moisture and corrosion. Power lead-ins are sealed at the motor shell with a non-hardening compound. Extra wide pre-lubricated ball bearings containing special greases re-



sist the adverse conditions of dust, temperature, humidity and speed. Under normal operating conditions these bearings will not require lubrication for at least five years. Extra insulation between each coil provides 3 to 4 times more protection than if used between phase groups only. End-to-end "clean sweep" ventilation eliminates converging air currents that deposit dirt. Auxiliary air passages in the rotor core assembly enable the air to circulate through the rotor as well as between the windings and the shell. The four additional ratings will be made in NEMA frames 444, 445, 504 and 505.

37—Large air volume is conditioned

The Kathabar System of humidity conditioning, which employs the adsorption method, is now being applied to extremely large air conditioning needs, according to announcement by Surface Combustion Corp. Recent applications have involved the treating of over 250,000 cfm of outside air. It is claimed that by using the absorption process of humidity conditioning, hp requirements can be reduced by 90 per cent as compared with conventional refrigeration to accomplish the same dehumidification of the air. Special Kathabar units are now available for treating 100,000 cfm of air to reduce its moisture content from 80 F dew point at 100 F dry bulb to minus 70 F dew point. Large applications have been employed in special chemical processes and also in the atomic energy field.

Wanta pump something at lower cost?

CHECK HERE

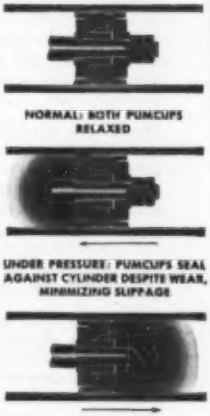
Air
Alcohol
Ammonia
Beer
Benzol
Boiler Feed Water
Brewer's Mash
Butter
Butane
Cane Syrup
Calcium Carbonate Slurry
Calcium Sulfate Slurry
Casein Solutions
Cement Slurry
Chocolate
CO_2 Gas
Crude Oil
Dairy Products
Dye Solutions
Edible Oils
Ethane
Fish Oils
Formaldehyde
Fresh Water
Gas, Manufactured
Gas, Natural
Gasoline
Glucose
Glue
Glycerine
Glycols
Hydrochloric Acid
Hydrofluoric Acid
Ink
Jam
Jelly
Ketchup
Lacquer
Latex
Mash
Methane
Milk
Molasses
Naptha
Nitric Acid
Nitrogen
Oil, Crude
Oil, Refined
Oxygen
Paint
Potassium Hydroxide
Propane
Raw Boiler Feed Water
River Water—Dredging Operations
Rosin
Salt Water
Shortening
Sludge
Soap
Sodium Chloride Solution
Sodium Silicate
Sodium Sulfate Solution
Starch
Sulphuric Acid
Sump Water
Sweet Water
Tomato Juice
Varnish
Vinegar
Viscose
Water (various)
Wax
Whey

THIS list of fluids will give you a rough idea of the diversity of pumping jobs in which Darcova Pumcups are responsible for really *big* savings.

It boils down to the fact that Pumcups all but eliminate fluid slippage *throughout* their life span . . . and they *last many times as long as other packings.* Think of the down-time avoided, the production gains due to prolonged high efficiency, and the time-and-money-saving reduction in maintenance!

Years of application research have gone into the development of Pumcups. Made today in standard as well as many special compositions and textures for a wide range of temperature and pressure conditions, they offer you superior cost-cutting service in virtually *any* pumping job, simple or tough! And they're available in diameters from 1 to 20 inches.

DIAGRAM OF DARCOVA PUMCUP ACTION (greatly exaggerated)



NORMAL: BOTH PUMCUPS RELAXED

UNDER PRESSURE: PUMCUPS SEAL AGAINST CYLINDER DESPITE WEAR, MINIMIZING SLIPPAGE

SEND FOR FREE BULLETIN

Why not weigh *all* the facts? Bulletin 4401 covers Darcova Pumcups for reciprocating pumps; Bulletin 4502 on Pumcups for air or hydraulic mechanisms. Write for yours today.

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT 9, PA.

DARCOVA
THE ORIGINAL COMPOSITION CUP
PUMCUPS

Avoid Plant Shut-Downs Due to Gas Failure!

Install a Pritchard LP-Gas Standby Plant.

Wintertime gas supply failures need no longer be a threat to the uninterrupted operation of your plant. Now you can be sure of continuous operation and production during emergency periods with a Pritchard LP-Gas Standby Plant.

There is no need to switch over to a more costly year-round fuel either! A Pritchard LP-Gas Standby Plant uses *low-cost* liquefied petroleum gas and can be easily turned on in a matter of minutes without extra burner equipment or adjustments. Fuel can be delivered by rail or truck at any time and stored for future emergency use. Butane or propane-butane gas mixtures can be used interchangeably.

Don't let the bogey of gas supply failure cause unnecessary shut-downs of your plant! Let Pritchard's experienced gas engineers give you an estimate on a Pritchard LP-Gas Standby Plant engineered to your specific requirements. Your inquiry invited.

J.F. Pritchard & Co.

DESIGN • ENGINEERING • CONSTRUCTION

Dept. 229 908 Grand Ave., Kansas City 6, Mo.

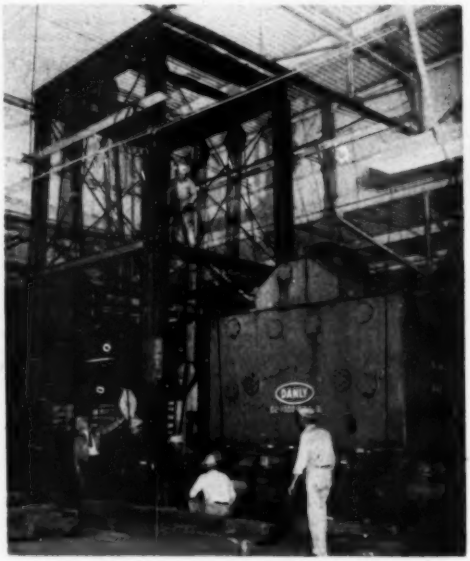
District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
ST. LOUIS • Representatives in Principal Cities from Coast to Coast

Spot news

(*Continued from page 122*)

Difficult Erection Problem Solved by Company's Industrial Engineers

What started out as the simple installation of another piece of equipment ended up as a difficult engineering problem when Texas Engineering and Manufacturing Company, Inc., Dallas, Texas recently received a 1000 ton Danly mechanical double-action forming press. The problem was how to get the giant press which weighed over 200,000 lb and stood over 30 ft high into an area with an overhead clearance of a little over 33 ft, and do it without disturbing production only 8 ft away. Normally, when



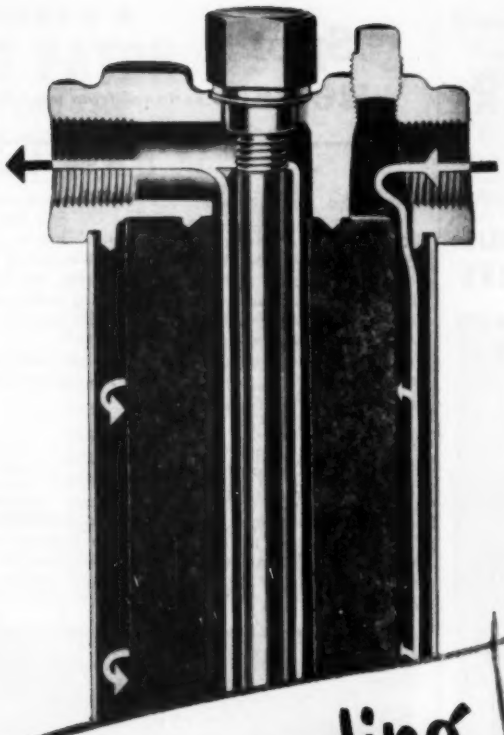
60 ton top section of double-action mechanical forming press being slid into place for hoisting during erection

one of these presses is installed, the three sections are assembled one on top of another with giant cranes, and four 25 ft x 6 in. tie bolts are dropped in from the top to clamp them together. Following this procedure, however, would have meant removing a large section of the roof which not only would have been costly, but also would have meant exposing adjacent factory areas to the weather.

The problem was turned over to the company's engineering department. Unable to go up without raising the roof, the engineers reversed their field and went down. Four foundation pier holes 25 ft deep were bored into the ground, and after attaching eye-bolts to the upper ends, the tie bolts were lowered into the holes. The bottom section of the press was then placed on the foundation.

Next a gallows of 14 in. steel H-columns 33 ft high

(Continued on page 164)



No Channeling with this micronic filter

Won't shrink, won't swell. Won't harden, won't soften. Won't distort in any way. That's Cuno MICRO-KLEAN . . . the filter that outlasts any other replaceable-cartridge filter 2 to 1!

CUNO

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

Fluid Conditioning

Get Dry, Clean Air the Positive Way

Entrained moisture and dirt in compressed air just don't *find* a way to get through a Cuno MICRO-KLEAN Air Line Filter.

As the cutaway shows, the air entering the filter first encounters a baffle (A) which deflects some moisture down outside the cartridge.

Then the air is forced into the porous fibre structure of the cartridge (B), being required to make many sharp turns through ever-narrowing passages, impinging eventually on the fibres.

The moisture promptly drains off these non-wicking fibres into the large collection chamber (C).

Fewer Cartridge Changes

There's more room for dirt in the MICRO-KLEAN cartridge . . . meaning you need to change it less often—*half* as often.

That's because its exclusive construction—"graded density in depth"—reduces surface loading and permits smaller particles to penetrate to varying depths.

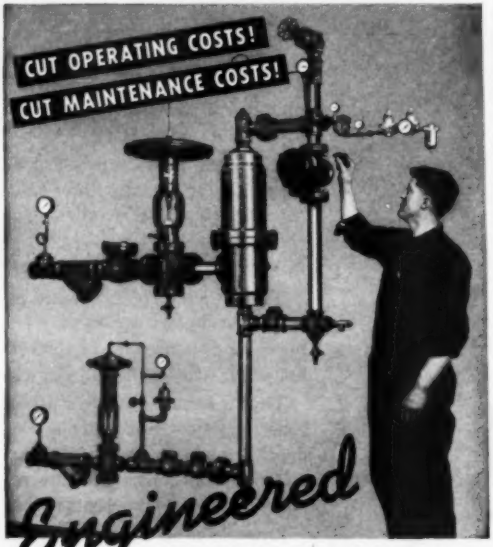
Pressure drop across the cartridge is slight due to the openness of the structure—80-90% porosity—and to the absence of purely structural components (none needed) that offer resistance to flow.

Test Cuno MICRO-KLEAN Air Line Filters on your equipment—pneumatic tools, air-operated instruments, spray systems, etc.—and be *sure* of dry, clean air.

Cuno Engineering Corporation
Dept. 148D, South Vine Street, Meriden, Conn.
Please send information on Cuno MICRO-KLEAN
Air Line Filters for.....
(mention application)
Name.....Title.....
Company.....
Address.....
City.....Zone....State.....
Please attach to business letterhead

THE SURE WAY TO
CUT HOT WATER
Costs!

Pick INSTANTANEOUS WATER HEATERS



TO PROVIDE
ANY VOLUME OF WATER
AT THE TEMPERATURE REQUIRED!

Here's the money-saving answer to hot water required for industrial needs. PICK Heaters provide hot water *instantly* — by steam injection. They're entirely automatic to provide and accurately maintain temperatures up to 180° F. The exclusive Pressurizer Piston stabilizes injection pressure — eliminates pipe hammering and shaking. Available in seven sizes with rated capacities of 10 to 200 gallons per minute. Greater volumes can be obtained by multiple installations. Installation is simple, requiring only ordinary pipe connections.

NO STORAGE TANKS NEEDED
Compact design permits installation in corners, on walls or overhead.

EASILY CLEANED
No coils. Can be cleaned in a matter of minutes — without dismantling.

Proved
BY PERFORMANCE IN
FACTORIES • HOSPITALS
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CANNERIES

For Engineering Details and Specifications, Write Dept. IP1

MANUFACTURED BY
PICK MANUFACTURING CO.
WEST BEND, WISCONSIN, U.S.A.

Spot news

(Continued from page 162)

was erected. Using the lower section of the press as a base, the top section weighing 60 ton was slid over the lower section and then raised inside the gallows frame by jacking, cribbing and hoisting. After it had been raised 11 ft, the center section was slid into place between the top and bottom sections. Cables were then attached to the eye-bolts which were then threaded up through the press to clamp the sections together.

According to the engineers this method not only avoided cutting the roof but also saved two weeks erection time and permitted production to continue.

Prestressed Concrete Beams Use a Minimum Amount of Steel

Acute shortages have made it necessary for designers of buildings to use a minimum of steel in structural framework. One solution for the replacement of steel in structural work may be the use of prestressed concrete. The

Cables in 60 ft prestressed concrete beam are shown being post-tensioned with center-hole 60 ton hydraulic jack

Austin Company, in its first industrial application of the technique, employed prestressed concrete beams for a new addition to The F. W. Wakefield Brass Company's plant in Vermilion, Ohio.

Each of the girders in this plant were 60 ft prestressed concrete beams, containing 60 strands of ¼ in. wire with a specified minimum ultimate strength of 215,000 psi. Five thousand-pound concrete with a maximum slump of 2

(Continued on page 166)

HERE'S A
HOT PATCH
FOR THE
COLD WAR

Many water softeners and water filters are too good to discard. But they are too old to be efficient, and too complicated to operate and control.

These units can be equipped with new high capacity, high efficiency resinous zeolite beds, new filter beds, strainer systems, and **H. & T.** poppet type multiport valves. Then they will have automatic operation, and be transformed into attractive and efficient water treating units. Let us give your water treatment facilities a hot patch for the cold war.

Write Us For The Name Of Our Nearest Representative

(Use your CMP-MRO priority)

There are 34 H. & T. Sales Offices To Serve You

HUNGERFORD & TERRY, INC.
CLAYTON 1, N. J.

Give 'em the BUM'S RUSH!

Don't let Dirt, Dust, and Grit spoil the working efficiency of your machinery and equipment. Rush 'em out of every crack and crevice with a CLEMENTS-CADILLAC blower-suction cleaner. Easy to use, economical. Ask your mill supply dealer.

Eligible under C.M.P. regulations.

SAVE
TIME • MONEY
PREVENT DAMAGE
TO MACHINERY
WITH THE . . .

Made in 5 models with attachments for every cleaning job.

PORTABLE COMBINATION BLOWER-SUCTION CLEANER

CLEMENTS CADILLAC

CLEMENTS MFG. CO.
6428 S. NARRAGANSETT AVE., CHICAGO 38, ILL.

ASK YOUR MILL SUPPLY DEALER OR WRITE US FOR DATA

SAFE
Moisture and Fume Removal

GALLAHER Air Van®
POWER EXHAUSTER

Expel moisture and fumes without the danger of motor damage. Exclusive Scroll Effect design, built-in, assures efficiency against normal static pressures. Positive air seal-off prevents passage of fumes into motor housing.

Air-Vans are weatherproof and completely self contained. No penthouses necessary. Direct connected. Construction Heaviest of any comparable unit.

Pat. 2188741 2526290

Ratings tested and certified by an independent laboratory. Capacities 150-11,000 CFM Static Pressures to 1¾" Ideal low silhouette design.

For full technical information contact your Gallaher Representative or write the Gallaher Company, Dept. F, 4108 Dodge Street, Omaha, Nebraska.

The GALLAHER Company
Omaha, Nebr. Owatonna, Minn.

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with a
LIQUIDOMETER
Tank Gauge

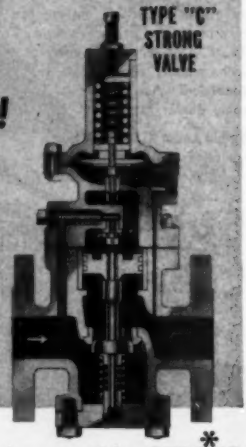
- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

THE LIQUIDOMETER CORP.
36-32 SKILLMAN AVE., LONG ISLAND CITY, N. Y.

GET THIS VALVE!

Accurate pressure regulation!

TYPE "C" STRONG VALVE



FOR HEATING OR PROCESS JOBS:

- ...with intermittent or fluctuating demand;
- ...requiring accurate control;
- ...where dependability is essential.

For positive control, use this STRONG single-seated, pilot-controlled valve!

Simple design, extra-heavy construction make STRONG's Type "C" regulating valve give trouble-free regulation. Semi-steel for pressures to 250 psi, 450° F.; cast steel to 600 psi, 750° F. With Anum-Metl† seat and disc, this valve automatically adjusts itself to control the flow of steam, air or gas required to maintain reduced pressure.

Write us about your pressure reducing problem or request our complete steam specialties Catalog 68-J.

TYPE "O"

Direct operated. Semi-steel construction suitable for initial pressures to 225 psi, 400° F. For steam, air, water or gas.

Features internal strainer, Anum-Metl† seat and disc. Direct operated, of extra heavy semi-steel, this valve is suitable for pressures to 225 psi, 400° F.

TYPE "K"

*Trade Mark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd Street
Cleveland 13, Ohio

† ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

No. 070 Small Trap

"SY" Strainer

800 Series Steel Trap

STRONG

Spot news

(Continued from page 164)

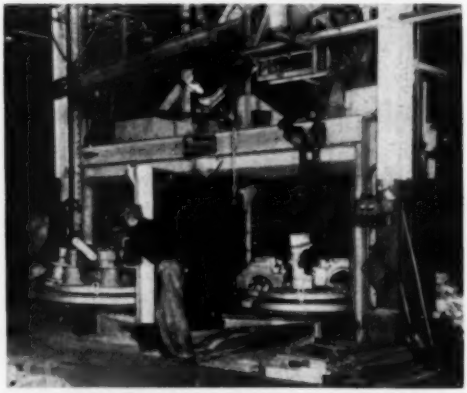
in. was used in the beams, which are 40 in. deep with a 30 in. top flange and a 6 in. web, except at the bottom where a 12 in. flange is 8 in. thick. Each girder weighs approximately 13 ton. Other structural members of the building are of ordinary reinforced concrete or steel.

Very little prestressed concrete construction, which uses less than one-third of the steel required for ordinary steel framing, has been used in this country. Much work of this kind has been carried out abroad, however.

Three essential differences between prestressed concrete and ordinary reinforced concrete are: the entire cross section of the beam is under compression at normal loads; the steel is post-tensioned a week or more after the concrete is set; and the concrete used must have a much higher strength.

Eight Cleaning Units Blast Castings at Farrell-Cheek

Eight different blast-cleaning units are employed by the Farrell-Cheek Steel Company, Sandusky, Ohio, to reduce labor costs, speed cleaning, improve job quality, and increase foundry output of carbon and steel-alloy castings. This equipment includes one airblast room, one centrifugal-blast turntable machine, four 14 cu ft centrifugal-blast barrels, one 28 cu ft centrifugal-blast barrel, and one specially designed mass production machine. Each unit is designated to handle specific casting types and sizes.



Operator at Farrell-Cheek rotates cleaning room door which permits loading and blasting of castings simultaneously

Newest of the cleaning equipment is a Rotoblast "Turnstyle" table, manufactured by the Pangborn Corporation. This machine is used to blast large castings up to 6½ ft long, 5 ft high and 1500 lb. Abrasive is hurled against the work by centrifugal force as the work is passed under an abrasive-throwing "wheel". Work is placed on tables attached to each side of the cleaning room door which turns about a center axis in such a manner that the operator loads

(Continued on page 168)

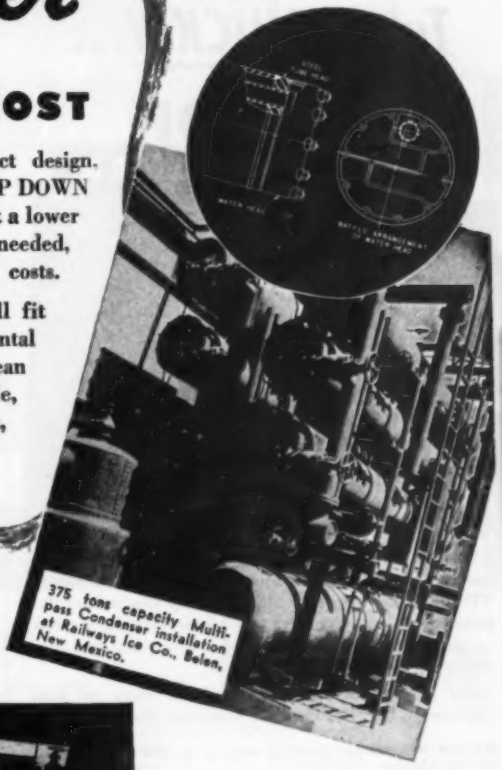
$ave Power
and
REFRIGERATION COST

Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

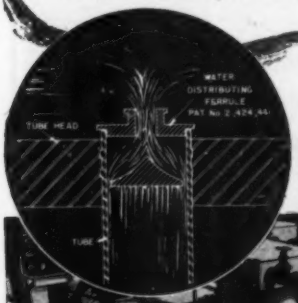
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

Horizontal Multipass Condensers
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

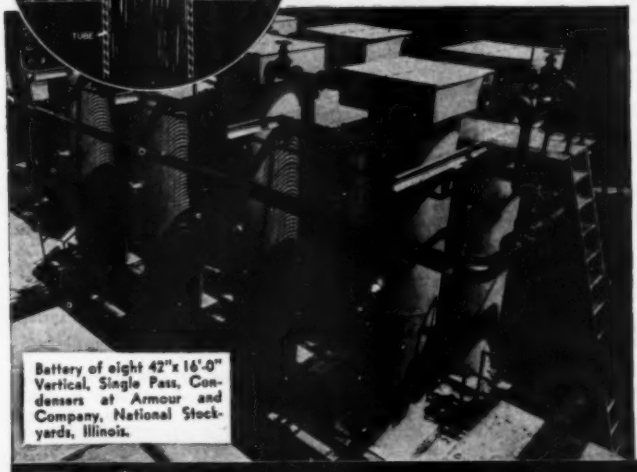


375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.



Vertical Single Pass Condensers
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

Write For Bulletin RC-1

HENRY VOGT MACHINE COMPANY
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Vogt REFRIGERATION CONDENSERS

CLEANS
Fouled Heat Exchanger Tubes QUICKLY...

WILSON
TP-301 CLEANER

This high speed tube cleaner is designed to increase output and minimize down-time. The improved Model TP-301 is the only tube cleaner which can remove deposits from completely plugged heat exchanger tubes . . . and other fouled straight tubes heretofore not considered practical to clean.

Many improvements, resulting from years of field experience, have been built into the new TP-301 cleaner.

- **MORE POWERFUL**—operating speed up to 3500 RPM at 90 psi utilizing 130 cfm.
- **LIGHTER WEIGHT**—only 15 lb.
- **SHORTER**—only 13" overall.
- **INCREASED CAPACITY**—from 3/8" up to 2½" or even 3" O.D. tubes up to 40 ft. in length.
- **LOW AIR PRESSURE**—operates on air pressure as low as 50 lb.
- **LOW HEAD ROOM NEEDED**—minimum practical working head room 5 ft.
- **COSTS LESS** than previous models.

VARIOUS CARBIDE BITS AVAILABLE

Send for Bulletin giving complete details on this man-hour and money-saving tube cleaner

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THOMAS C. WILSON, INC. 21-11 44th AVENUE, LONG ISLAND CITY, N.Y.

CABLE "TUBECLEAN" NEW YORK

TW-704A

WILSON
TUBE CLEANERS · TUBE EXPANDERS

Spot news

(Continued from page 166)

one table with up to 1.5 ton of castings while the other table is inside the room under the cleaning stream. With this unusual arrangement it is possible for the cleaning machine to bombard castings 85% of the time, being stopped only to turn the door. Green work is blasted eight minutes and annealed castings twelve. The machine averages 40 to 50 loads per 8 hr day.

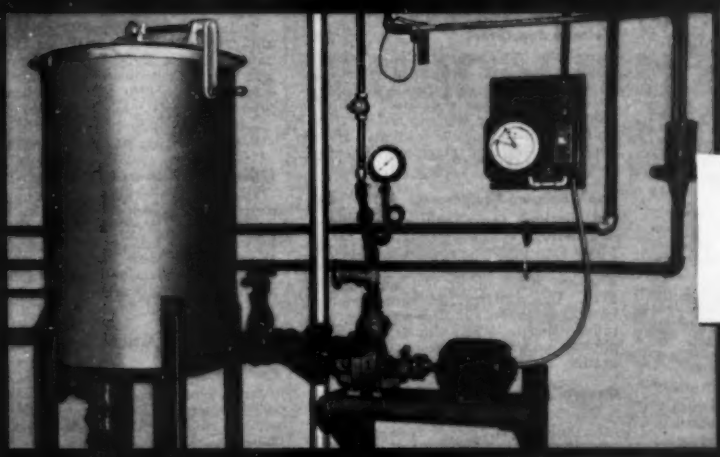
Emergency Stand-By Units Supply Power Automatically

When the new Kalamazoo plant of The Upjohn Company was built, the architects anticipated the need for emergency power and specified stand-by power units to be built into the structure. Six Kohler 115/230 v a-c stand-by electric plants, each rated at 10 kw, were installed. They are powered by 22 hp water-cooled gas engines which

One of six automatic electric plants installed at Upjohn to supply emergency power for lighting and alarm system

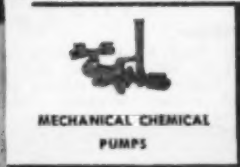
automatically go into action the instant central power fails, and shut themselves off when central power is restored. They also adjust themselves to changes in the electrical load while they are in operation.

Power is supplied to a special 3-wire, single phase emergency lighting circuit. In addition, the stand-by units power an autocall system used to summon department heads, maintenance men, electricians, first aid teams and others in case of emergencies. A general fire alarm can also be given over the system, as well as coded alarms to indicate the location of fires.

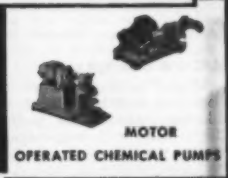


AUTOMATIC INTERMITTENT FEEDING

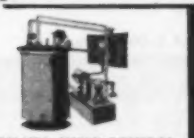
BY-PASS FEEDERS



MECHANICAL CHEMICAL PUMPS



MOTOR OPERATED CHEMICAL PUMPS



AUTOMATIC CYCLE CONTROL

WATER TESTING CABINETS

FLO-CONTROL VALVES —TIMERS

Dearborn has the ENGINEERED EQUIPMENT for your water treatment

To get the most from your water treatment, it's essential that the entire system be engineered for maximum efficiency.

Here Dearborn will help by analyzing your existing equipment and physical layout. With this information, a Dearborn engineer will then recommend the necessary equipment, whether it is to include a pump or timer—a test cabinet—or an automatically controlled feeding system.

Why not plan to discuss your water treatment and other boiler room problems with your Dearborn engineer? He will bring you all the benefits of Dearborn's broad experience in this field since 1887.

DEARBORN CHEMICAL COMPANY

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WRITE FOR INFORMATION ON THE EQUIPMENT YOU NEED

Use the coupon!

Dearborn Chemical Company, Dept. INP
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- ☐ De-ionizing units
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- ☐ Cooling water samplers
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Please send information on the items checked above.

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THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

New bulletins and catalogs

(Continued from page 32)

for distribution and power dry-type transformers in ratings above 50 kva 600 v, cooled by natural draft or forced draft. Allis-Chalmers Mfg. Co.

Switchgear **238**

Air blast breaker cubicle switchgears in both industrial and station type designs are the subject of illustrated 16-page brochure P.012-3058. Sections covering general descriptions, safety features, types of cubicles, standard ratings and dimensions, specifications, design and operation of breaker, and how to order are arranged for quick reference. Brown Boveri Corp.

A-C & D-C Relays **239**

Useful information to relay users, including how to order, is presented in 12-page catalog R-10. Includes detailed discussions and engineering data for many models and specialized types, and illustrations of each. American Relays & Controls, Inc.

Switch & Outlet Boxes **240**

Handy wall chart features switch, outlet and utility boxes. Shows at a glance catalog numbers, sizes, number and sizes of conductors permitted in each box. For convenience each item in chart is illustrated. Reverse side of chart lists advantages of the units. General Electric Co., Construction Materials Div.

Voltage Regulators **241**

Details, performance characteristics, applications, and principles of operation for automatic electronic or electro mechanical voltage regulators are presented in 12-page bulletin S-351. Illustrated with photos, dimensional drawings and electrical diagrams. The Superior Electric Co.

Tap Changing Equipment **242**

Underload tap changing equipment for single-circuit unit substations, three-phase step voltage regulators up to 750 kva and L.R.C. transformers up to 7500 kva are featured in 16-page bulletin 5112. Descriptions, design features, how it operates and accessories are fully discussed and illustrated with photos, cutaways, drawings and diagrams. Pennsylvania Transformer Co.

General Catalog **243**

Renewable, one-time and plug fuses, fuse pullers, clamps for fuse clips and test clamps are illustrated and described in 8-page folder F.L.B. 300-C. Many types of automatic oilers are also presented. Lists bulletins available for specific products. Trico Fuse Mfg. Co.

Capacitors **244**

Industrial capacitors in many sizes and types are presented in 28-page catalog 200C. Each type is illustrated and briefly described. Lists range of sizes together with pertinent data and prices. Cornell-Dubilier Electric Corp.

HOW TO REQUEST FREE BULLETINS

Insert "key" numbers on return post card found on page 131. Our Reader's Service Department will handle your request promptly.

ELECTRICAL HEATING UNITS

Electric Air Heaters **245**

Portable and built-in electric air heaters are described in illustrated 4-page folder F-1530. Convection, blower, duct and radiant types are shown along with suitable automatic controls. Application photographs illustrate factory and office uses. Edwin L. Wiegand Co.

FILTERS, STRAINERS & PURIFIERS

Purifiers **246**

Line type purifier removes almost 100% of entrainment from vapors, according to illustrated data sheet 200. Advantages, operation and dimensions are included. Applications listed include exhaust steam installations, compressed air lines, process gas lines and vapor lines following evaporation. V. D. Anderson Co.

Filter Gages **247**

Engineers concerned with filter plants will find 4-page bulletin 450-H10 of interest. Mechanically operated filter gages are described and illustrated with photos. Principles of operation and special features are discussed. Includes gage specifications and several layout drawings of typical installations. Builders-Providence Inc.

Filter Presses **248**

Filter presses for clarification of practically any liquid are the subject of 32-page catalog 52. How they operate, how to select, advantages, design features, materials of construction, filter media, applications and approximate costs are fully discussed and illustrated. Also presents horizontal plate-enclosed tank type pressure filter capable of average flow rates up to 60 gal per sq ft filtering area per hr. T. Shriver & Co., Inc.

Pipe Line Strainers **249**

Pipe line strainers from ½ to 36 in. are described and illustrated in 16-page data manual 951. Includes useful information on factors in selecting types and sizes for specific applications, and the effect of flow rate, screen loading and viscosity of fluid on pressure drop. J. A. Zurn Mfg. Co.

FUELS & FIRING EQUIPMENT

Gas Burner **250**

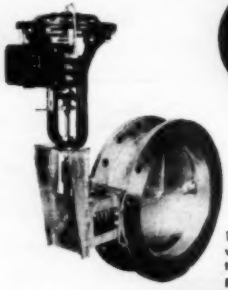
If you are considering the use of gas as a fuel, technical data sheets B 22/1 and B 22/2 may be of interest. Specifications and installation data are presented. Drawings of suggested methods of application are included. The Webster Engineering Co.

Combination Burner **251**

Do you purchase gas on an interruptable or curtailable basis? Gas and combination gas and oil burners are

For Air • Steam • Water
Hot • Abrasive • Corrosive
Gases, Liquids, Semi-Solids

Install
ROCKWELL VALVES



- Manual or Automatic Control and Quick, Tight Shut-Off
- Made of any metal or rubber-lined
- Butterfly, Wafer Butterfly and Slide Valve Types, Threaded or Flanged
- Pipe sizes to 72" and larger

10" heavy duty, rubber-lined steel butterfly valve for 90 p.s.i.; with air cylinder controller and auxiliary clutch and handwheel.

18" alloy steel butterfly valve for 1100° F. operating temperature; with air diaphragm operator and valve positioner.

Write for Catalog and "The Valve News"

ROCKWELL SINCE 1888 BUILT

W. S. ROCKWELL COMPANY
Slide and Butterfly Valves • Steam Traps • Oil Burners
230 Eliot Street • Fairfield, Conn.

featured in a 4-page brochure AD-101 that states any type of gas can be utilized. The combination burner also burns No. 5 oil. Capacity from 16 to 190 bhp. Booklet is informative and well illustrated. Cleaver-Brooks Co., Hev-E-Oil Burner Div.

Burner Tips **252**

Complete line of burner tips for various gas-fired applications is described and illustrated in 28-page catalog B-11. Includes advantages and engineering data. Also lists such equipment as industrial carburetors, hand torches, fire pots, peep hole covers, fire checks, dynamic dryers and immersion heaters. The C. M. Kemp Manufacturing Co.

FANS & BLOWERS

Draft Inducers **253**

Draft inducers help to reduce or eliminate smoke and obnoxious gas, according to 4-page folder I-51. Unit containing welded steel axial-flow fan is described and illustrated. Selection table and general dimensions are included. L. J. Wing Mfg. Co.

HEAT EXCHANGER EQUIPMENT

Heat Exchangers **254**

Cascade type heat exchanger utilizing specially constructed Pyrex glass tubes is featured in 12-page bulletin PE-8. States they provide an efficient economical means of cooling corrosive liquids. Drawing and photos aid in presentation of data on construction and installation details. Charts and nomographs are included to aid in the calculation of heat transfer requirements. Corning Glass Works, Technical Products Div.

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

Separators **255**

Informative 44-page booklet S. A742 may solve your problems of separation and clarification. Variety of industrial centrifugals of continuous separator type are featured. Comprehensive explanations of how they operate, construction and special features are included. Booklet is well illustrated with photos and cutaways. List of applications includes clarification and reclamation of many oils in power plants and engine rooms. De Laval Separator Co.

MECHANICAL POWER TRANSMISSION

Load Computation Manual **256**

You will want this valuable 68-page manual of short-cut methods for calculating loads on bearings for your engineering file. Contains many valuable formulas and tables. Manual is step-indexed for quick reference. Marlin-Rockwell Corp.

Roller Chains **257**

Double pitch roller chains are pictured and described in 12-page bulletin 51-2. While not a substitute for standard chains the booklet describes how these chains can often effect both cost and weight reductions in drives and conveyers for applications where

(Continued on page 172)

WESTON *Readable* ALL-METAL THERMOMETERS

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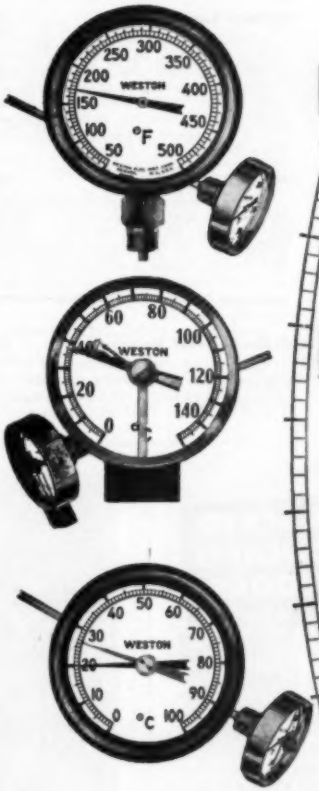

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All-metal dial types with stainless steel stems, in straight and angle forms. Scale lengths 3"—6" and 9", with stems from 2½" to 72". Available as testing thermometers, and for general purpose and heavy duty service. Ranges from −100 to +1000°F. All-metal construction prevents breakage, assures dependable accuracy for longer periods.

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Combines the features of the all-metal indicating thermometer with an alarm or control device. Has adjustable contact arm mounted in the glass and bezel. Supplied to make contact on increasing or decreasing temperatures. Has positive magnetic type contacts. Contact rating . . . 100 ma at 110 volts a-c; 50 ma at 110 volts d-c. Stem lengths 2½" to 24".

MAX-MIN® THERMOMETERS

Equipped with a manually set red index which moves up or down scale with pointer, remaining at extreme temperature reached until reset. Thus one reading gives present temperature, and maximum or minimum reached since last reading. Available in scale lengths of 6" and 9"—stem lengths 2½" to 24".

Literature describing Weston all-metal, as well as electrical and glass thermometers, sent on request. WESTON Electrical Instrument Corporation, 605 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and TAGliabue instruments.

WESTON *Instruments*

New bulletins and catalogs

(Continued from page 171)

speeds are slow to medium, loads are moderate, or where centers are long. Charts, photos, diagrams and tables show in detail both drive and conveyer types, and standard attachments. Useful selector chart makes it simple to choose chains. Also describes double pitch chain sprockets. Chain Belt Co.

V-Belts **258**

Features built into Condor V-belts are described in 4-page bulletin 6868E. Construction features are explained and typical applications in various industries illustrated. Table of standard industrial sizes and list prices included. Raybestos-Manhattan, Inc., Manhattan Rubber Div.

MATERIALS OF CONSTRUCTION

Metal Mesh **259**

"How to make a little metal go a long way" is the theme of a 26-page booklet 493 EM. This instructive booklet illustrates many interesting and useful applications using metal mesh, including numerous machinery and belt guards, enclosures and gratings. Included are complete engineering specifications on numerous types of mesh, photos in actual size, and a section on accessories used for fabricating parts. A special section on techniques of fabricating expanded metal, and engineering data on air flow through several types of mesh are featured. Penn Metal Company, Inc.

MOTORS & GENERATORS

Motors **260**

Complete data on heavy duty single phase and polyphase motors are presented in 8-page catalog. Motors range in size from 1/20 to 5 hp. Prices are also included. Triad Engineering Corp.

Voltage Regulators **261**

Application, construction, operation and installation of Rocking Contact voltage regulators for small alternating current generators is described in a 4-page folder D-51. Illustrations include photos, construction detail diagram, and dimensional drawings. Allis-Chalmers Mfg. Co.

Motor Control Center **262**

If you need a motor control center for two or more a-c motors up to 200 hp, 600 v, 24-page brochure GEA-4979A may be of interest. Installation and design features are photographically illustrated. Includes complete specifications and selection charts. General Electric Co.

Explosion-proof Motors **263**

Application and construction of explosion-proof and totally-enclosed motors is discussed in 8-page bulletin 1629-80M. Well illustrated with 4-color photographs, cross sections and large cutaway drawing of motor. U. S. Electrical Motors, Inc.

PACKAGED STEAM GENERATORS

Packaged Steam Generators **264**

"Steam in a package", 14-page booklet ID-51-115, presents 3-pass packaged steam generators from 525 to 8625 lb steam per hr. Booklet is well illustrated with photos and drawings, and features 2-page, 3-color cutaway of the unit. Advantages, construction, and how it operates are presented in a quick reference style. York-Shipley, Inc.

Packaged Steam Generators **265**

Basic construction and design features of plant assembled steam generators, with or without superheat, are presented in illustrated 20-page booklet P6-51-2. Includes tables of engineering specifications for units from 10,000 to 30,000 lb steam per hr and design pressures from 250 to 825 psi. Also includes section on control and instrumentation. Foster Wheeler Corp.

PACKINGS & GASKETS

Asbestos Packings **266**

High pressure asbestos packings with rubber back, rubber core, or dual edge designed for use on valve stems, piston rods, pump shafts, and expansion joints are illustrated and described in 4-page bulletin. Includes service recommendations, list of standard sizes,

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and specifications of standard packages and approximate weights. Raybestos-Manhattan, Inc., Packing Div.

Packings & Gaskets **267**

How to get the best results from packings is outlined in useful 6-page folder PK-61-A entitled, "Packings for the Power Plant". Each of 28 types of packings and gaskets is illustrated, briefly discussed and numbered for quick reference. These numbers are then used on a schematic drawing of a power plant to indicate recommended applications. Johns-Manville.

Packing Rings **268**

Graphitic non-metallic packing rings are featured in 4-page folder R 112. Advantages, applications, and valuable information on how to order are included. Also presents a liquid-end piston for reciprocating pumps which simplifies packing installation. Sims Pump Valve Co., Inc.

Felt Gasketing **269**

Corrosion resistant impregnated felt gasketing is the subject of 6-page folder SP-1050-5M. Material is stated to be extremely versatile and many diversified applications are discussed and illustrated. Advantages and available sizes are included. Products Research Co.

Rubber Sheet Packings **270**

Engineering specifications, descriptions and recommendations for a complete line of rubber sheet packings are presented in a brief, easy-to-read 8-page bulletin. Standard packages and weights are also included. Raybestos-Manhattan, Inc., Packing Div.

PIPE & FITTINGS

Expansion Joints **271**

Corrugated expansion joints solve vibration, misalignment and expansion problems in scores of industrial applications, according to 16-page booklet CMH-127. Designs, applications and data for several types suitable for use from vacuum to 5500 psi and -400 to 1600 F are discussed and illustrated in quick reference style. A section intended to act as a guide for proper selection and application includes numerous tables, data and formulas which you may want in your files. Flexonics Corp., (formerly Chicago Metal Hose Corp.)

ERW Tubing **272**

If you are concerned with ERW tubing for mechanical and pressure purposes, a chart now being offered should be a useful addition to your engineering data files. Chart covers tubes from ½ to 4 in. OD, in various carbon steel grades and produced to meet numerous standard specifications. Both average and minimum wall requirements are covered. Babcock & Wilcox Tube Co., Welded Tube Div.

Tubing Maintenance **273**

"Some Experiences in Service", 40-page booklet TR-516, should be of assistance to engineers concerned with obtaining failure-free service from high-pressure, high-temperature tubing installations. Results of many investigations of failures in tubing used in such equipment as boilers, cracking stills, heaters and heat exchangers are presented and illustrated. The Babcock & Wilcox Tube Co.

PUMPS

Pressure Generator **274**

Automatic pressure generator for hydrostatic testing or as a booster in hydraulic systems is discussed and illustrated in 4-page bulletin AO-51. Pump, which uses ordinary plant air supply, is available in various models ranging from 25 to 25,000 psi with capacities from 4.1 to 405 gph. Typical pressure system and design features are presented. Milton Roy Co.

Centrifugal Pump **275**

Grease-lubricated pedestal-mounted centrifugal pump is illustrated and discussed in 6-page bulletin 52B6351B. Available in capacities to 2500 gpm at heads to 550 ft, with stuffing box or mechanical seal, direct or V-belt drive, and in a choice of materials to handle

(Continued on page 174)

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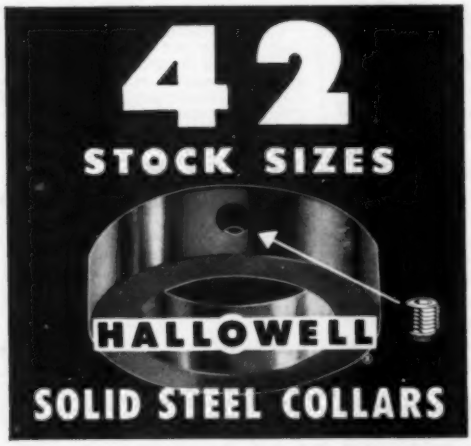

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For Dial Indicating and Recording Thermometers, Send for Catalog 325.

New bulletins and catalogs

(Continued from page 173)

almost any liquid at temperatures to 250 F. Large cutaway used to show all working parts and design features. Pedestal arrangements and table of dimensions are included. Allis-Chalmers Mfg. Co.

High-pressure Pump **276**

If you need a source of high pressure fluid power, this 6-page folder presenting an integral electric drive plunger type pump should be of interest. Pump is available in capacities from 1.03 to 62.58 gpm and 1200 to 20,000 psi. Folder incorporates large cutaway to illustrate design features, and several case histories are presented to demonstrate applications. Specifications are also included. Kobe Inc.

Centrifugal Pumps **277**

One and two stage volute, saddle-mounted, vertically split centrifugal pumps for refinery service are described in a 12-page bulletin W-341-B2C. Illustrated with dimension and cross section line drawings. Worthington Pump & Machinery Corp.

Wet-pit Pumps **278**

Bulletin W-317-B12 describes line of pumps having non-clogging impellers capable of passing solids and stringy material for sump, sewage and drainage service. The stuffing box is above the impeller and the pump bearings are above and separate from the box. Stuffing box packing requires no adjustment. Bulletin includes cross-section drawing, graph of 60-cycle motor speeds, dimensions and data on flanges. Worthington Pump & Machinery Corp.

Centrifugal Pumps **279**

Non-clogging centrifugal pumps for general industrial and specialized uses are featured in 18-page catalog 250. Design features, principles of operation, applications and engineering data are discussed and illustrated. Useful information on loss of head due to friction, viscosity of liquids, how to figure head on a pump, suction and discharge piping, effects due to change of speed, and maintenance suggestions are included. Tri-Clover Machine Co.

Ejectors **280**

Informative 20-page bulletin 512 presents complete line of jet pumps, ejectors, eductors, exhausters, and syphons. In addition to standard models, numerous special purpose models are described, and pumps of special materials can be supplied in some types. Illustrated sections on jet pump principle and typical application arrangements are featured. Booklet contains complete engineering information and prices. Penberthy Injector Co.

Centrifugal Pumps **281**

Construction features and specifications for several types of centrifugal pumps are presented in illustrated 12-page bulletin W-350-B11A. In addition to general duty pumps, several types are for corrosive liquids. Mechanical seals are also presented. Worthington Pump and Machinery Corp.

Centrifugal Pumps **281**

Illustrated 40-page instruction booklet 08X7613, containing complete information on installation, operation and repair of single-stage, double-suction centrifugal pumps, will be of interest to you. Includes a quick reference guide listing 40 possible causes of trouble in pump operation and their cures. Also contains a page to be used as a permanent record, which is arranged to enable the pump operator to see at a glance the life of any parts replaced or improvements due to substitute materials. Allis-Chalmers Manufacturing Co.

Rotary Pumps **283**

Heavy duty, vane type rotary pumps are the subject of illustrated 4-page bulletin W-485-B1. All models are positive displacement, sliding vane type, and are manufactured with both external and internal bearing design. Worthington Pump & Machinery Corp.

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STEAM SPECIALTIES

Steam Traps **284**

Float-thermostatic steam traps—how they operate and advantages—are illustrated and discussed in 4-page folder 450-A. Capacities range from 70 to 110,400 lb condensate per hr. List of prices and capacities is included. Sarco Co., Inc.

TANKS

Tank Capacity Chart **285**

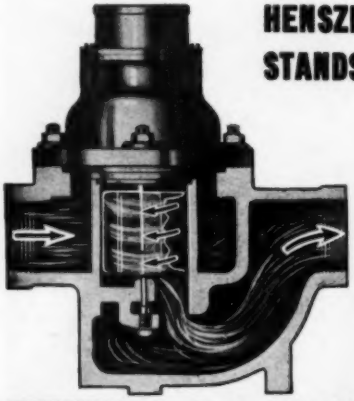
Handy chart for figuring gallons of a liquid in any horizontal tank without the use of tables, formulas or computations. It is printed on 8½ x 11 in. card suitable for hanging on wall for quick reference. Armstrong Machine Works.

Vent Valves **286**

Features, advantages, specifications, prices and operating data for pressure-vacuum vent valves, with or without flame arrestor element, are presented in 24-page illustrated bulletin E-601. Includes 14 relieving capacity charts, one for each valve size. Black, Sivalls & Bryson, Inc.

Expansion Roof Tanks **287**

Construction, types, features, and standard and special fittings for double deck floating roof storage tanks are described and illustrated in 20-page bulletin. Includes report by Underwriters Laboratories, Inc. to determine fire retardant values of these tanks. Also includes useful charts of storage data obtained by studies in the petroleum field. Operating and cost



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comparisons are also presented. Graver Tank & Mfg. Co., Inc.

Fuel Oil Heaters **288**

Oil tank suction heaters and oil preheaters are described and illustrated in 6-page catalog 714. Advantages are explained and capacities and dimensions are listed. Hauck Manufacturing Co.

THERMAL INSULATION

Heat Insulation **289**

Hydrous calcium silicate insulation is the subject of 8-page bulletin KH3-517. Graphs, tables, drawings, and photos depict uses up to 1200 F. Forms from ¼ to 72 in. dia and vessels from 6 to 60 ft are listed. Data on physical characteristics, recommended thicknesses, efficiences and other application facts are also included. Owens-Illinois Glass Co., Kaylo Div.

TOOLS

Tube Expanders **290**

Tube expanders for all types of steam boilers and heat transfer equipment are listed in 4-page illustrated catalog 204-C. Descriptions, illustrations and size and price lists of each type of expander are included. The Gustav Wiedeke Co.

Keyway Broaches **291**

Would you like to cut your own keyways by hand quickly, and at low cost? Keyway broaches and sets are described and illustrated in 8-page catalog I. Also includes reference information on keys and keyways for your files. Arbor presses and magnetic base for quick, convenient positioning of dial indicator gages are also described. The du Mont Corp.

Electronic Stethoscope **292**

"How to Cut Costs on Equipment Maintenance", 4-page folder, describes and illustrates electronic stethoscope for use by maintenance men to locate and diagnose trouble in mechanical equipment. Includes specifications and list of applications. American Name Plate & Mfg. Co., Anco Instrument Div.

Pipe Tools **293**

Information on pipe tools including pipe and bolt machines, ratchet threaders, reamers and cutters is contained in catalog and data book. Four pages are devoted to an instructive operating guide, which discusses and illustrates how to locate and correct pipe tool difficulties. Beaver Pipe Tools, Inc.

VALVES

Port Valves **294**

"How to select an air operated adjustable port valve" is outlined in a section of 12-page brochure 1800. Use of diaphragm actuators with adjustable port valves is discussed, and applications, principles of operation and engineering specifications are included. Minneapolis-Honeywell Regulator Co., Industrial Div.

Relief Valves **295**

Four page folder describes, illustrates, and lists specifications for pop-safety valves for steam, pressure-relief valves for such liquids as water and oil, and safety-relief valves for air, gas and vapor. Kunkle Valve Co.

TURBINES

Steam Turbine Generators **296**

Design and construction features of steam turbine generator units manufactured in NEMA ratings of 2000 to 7500 kw are described in 8-page bulletin 03B7654. Turbines are built in condensing, non-condensing and automatic extraction types. Cross sections and cutaways are employed to illustrate construction features. Bulletin points out how a wide range of applications can be met with a custom-built combination of standard components, due to flexibility and simplicity of design. Allis-Chalmers Mfg. Co.

WATER TREATMENT

Water Conditioning **297**

Water conditioning equipment including demineralizers, dealkalizers, softeners, deaerating heaters, degasifiers, filters and storage tanks are listed in 4-page folder. Arranged for quick reference, each item contains illustration and brief discussion. Penfield Manufacturing Co., Inc.

WELDING & CUTTING EQUIPMENT

Welding Electrodes **298**

If you are concerned with welding you may find 16-page welding alloys directory of interest. Contains photos, data and technical information on welding alloys for use on numerous metals and for cutting all metals. Includes chart of over 100 different welding alloys, their main uses, bonding temperatures and tensile strengths plus useful ideas on effective uses of welding. Eutectic Welding Alloys Corp.

Welding Rods **299**

Applications and procedures for production and repair welding, and for building up worn surfaces with bronze rods are suggested in 24-page booklet B-13. Welding techniques discussed include the oxyacetylene torch, metal-arc, carbon-arc, and inert-gas-shielded arc. Tabular data on copper and copper alloy welding rods are also included. The American Brass Co.

Welding & Cutting **300**

Full information on welding and cutting apparatus is presented in 64-page, 4-color catalog 20-C. Illustrations and charts are included to make selection and ordering as easy as possible. Victor Equipment Co.

MISCELLANEOUS

Spray Nozzles **301**

Non-clogging spray nozzles for spraying, washing and cleaning all kinds of materials and equipment are illustrated and described in 4-page folder 2386. Photos of typical installations suggest a few of the applications. Tables list dimensions of nozzles for 1 to 3 in. pipe, and capacities through orifices from 5/32 to ½ in. dia at 20 to 100 psi. Link-Belt Co.

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. . . In 1939, the U.S.A. under "competition" made ½ of all the world's steel. Today we produce half—all with only 6% of the people in the world.

. . . Steel workers under "competition" gained in jobs, too. There were 449 thousand jobs in 1939. Today—637 thousand.

The steel industry is just one example of how a free competitive system works. Ours is the security millions of people in the world dream of when they embrace such dead-ends as "planned economies".

Look around and see what happens when people hand their jobs and factories over to the government. Or have them taken by law. Or by force. Name it what you will—"communism", "nationalization", "socialism", "regimentation"—it is a one-way street, and no turning back. By then people no longer own government. Government owns the people.

• • •

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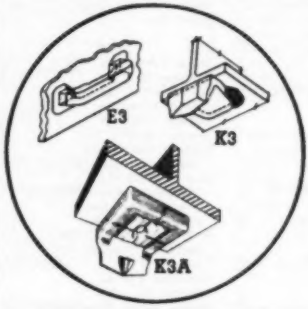

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For your reference file, following reprints free of charge:

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"Boiler Houses Are Not Necessary Evils", February, 1950

"Willmar, Minn., Increases Capacity of Municipal Power and Heating Plant", April, 1951

"Cooling System Layouts for Best Diesel Performance", September, 1951

"Diesels in A Hydroelectric System", June, 1950

"Caribou Diesel Plant Built in a Hurry", February, 1950

"Practical Considerations in Applying Axial-Flow and Mixed-Flow Pumps", Sept., 1951

"How to Select the Correct Steam Trap", January, 1950

"How to Select Corrugated Expansion Joints", June, 1950

"Harbar Plant Pioneers in Pneumatic Build-Up Refractory", December, 1950

"Streamlined Steam Plant Insulation", May, 1951

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ADVERTISERS' INDEX

Where an * appears after a name the advertisement does not appear in this issue, but appeared in one or both of the two previous issues

Acheson Colloids Corp. 111
Aerotec Corp., The 32
Airetool Manufacturing Co. 154
Albert Pipe Supply Co., Inc. ..175
Allis-Chalmers Mfg. Co. 21
Alloy Steel Products Co., The ..*
American Blower Corp. ....*
American Brass Co., The 52
American Brass Co., The American Metal Hose Branch 53
American Engineering Co. ....*
Ames Iron Works ....*
Anderson Co., The V. D. ....Fourth Cover
Armstrong Machine Works ....*
Arrow-Hart & Hegeman Electric Co. ....*
Atlantic Metal Hose Co. ....*
Atlas Chain & Mfg. Co. ....*
Atlas Valve Co. ....*
Aurora Pump Co. 178

•

Babcock & Wilcox Co., The Refractories Div. ....*
Bacharach Industrial Instrument Co. ....*
Baldwin-Hill Co. ....*
Barco Manufacturing Co. ....*
Beaumont Birch Co. ....*
Belco Industrial Equipment Div. 122
Bell & Zoller Coal Co. ....*
Betz, W. H. & L. D. 13
Bigelow Co. The ....*
Bird Archer Co. ....*
Bituminous Coal Institute 14, 15
Blaw-Knox Co. ....*
Boiler Engineering & Supply Co. 20
Buell Engineering Co., Inc. 138
Bussman Mfg. Co. ....*
Byron Jackson Co., Pump Div. ....*

•

Canton Stoker Corp. ....*
Chapman Valve Mfg. Co., The 159
Chemical Construction Corp. ....*
Chicago Pneumatic Tool Co. ..145
Childers Mfg. Co. 50
Clarage Fan Co. ....*
Clark Bros. Co., Inc. 4
Clark Mfg. Co. ....*
Clayton Manufacturing Co. 129
Clements Mfg. Co. 165
Clipper Mfg. Co., The ....*
Cochrane Corp. 180
Combustion Engineering Superheater, Inc. 10, 11
Cook's Sons, Inc., Adam ....*
Cooper-Bessemer Corp., The 41
Coppus Engineering Corp. 27
Crane Co. 7
Crane Packing Co. ....*
Cuno Engineering Corp. 163

•

Darling Valve & Mfg. Co. 161
Dart Union Co. 144
Davenport Besler Corp. Davenport Locomotive Div. ....*
Dayton Rubber Co., The 17
Dearborn Chemical Co. 169
Detroit Stoker Co. 125
Diamond Power Specialty Co. ..50
Drew and Co., E. F. 121
Ducon Co., The ....*
du Mont Corp., The ....*
Duramettallic Corp. 148

•

Eastern Gas & Fuel Associates ....*
Economy Fuse and Mfg. Co. ....*
Edward Valves, Inc., Subsidiary of Rockwell Mfg. Co. ....*
Elgin Softener Corp. 115
Engineer Co., The 151
Erie City Iron Works ....*
Ess Instrument Co. ....*
Everlasting Valve Co. 146

•

Ferris Stacon Corp. 172
Felt Products Mfg. Co. ....*
Fiske Brothers Refining Co. ....*
Flexonics Corp. 65
Fluor Corp. Ltd., The 49
Food Machinery & Chemical Corp., Peerless Pump Div. 33
Foster Wheeler Corp. 36, 37
Fuller Co. 157

•

Gates Rubber Co., The ....*
Gallaher Co., The 165
Gifford-Wood Co. ....*
Gilbert Associates, Inc. ....*
General Coal Co. 160
General Electric Co. 143
General Electric Co., Construction Materials Div. 26
General Electric Co., Industrial Vacuum Cleaners ..126
General Motors Corp., Hyatt Bearings Div. 68
B. F. Goodrich Co., The Industrial Products Div. 53, 54, 55, 56
Goodyear Tire & Rubber Co., The 3
Graver Water Conditioning Co. ....*
Greene, Tweed & Co. ....*
Grinnell Co., Inc. 47

•

Hapman-Dutton Co., Dutton Boiler Div. 117
Hartzell Propeller Fan Co. ....Second Cover
Hays Corp., The ....*
Heinemann Electric Co. 108
Hennessy Co. 174
Hewitt-Robins, Inc. ....*
Hilliard Corp., The 140
Hills-McCanna Co. 156
Hoffman Combustion Engineering Co. ....*
Houghton & Co., E. F. ....*
Hungerford & Terry, Inc. 165
Hyatt Bearings Div., General Motors Corp. 68

•

Ideal Industries, Inc. ....*
Illinois Engineering Co., Inc. ..179
Infilco Inc. 51
Ingersoll-Rand Co. ....*
International Nickel Co., Inc., The 62
I-T-E Circuit Breaker Co. 18, 19
I-T-E Circuit Breaker Co. Mechanical Rectifier Div. ....*

•

Jeffrey Mfg. Co. ....*
Jenkins Bros. ....*
Jerguson Gage & Valve Co. 149
Johns-Manville ....*

•

Kaylo Div., Owens-Illinois Glass Co. 25

ADVERTISERS' INDEX

Where an * appears after a name the advertisement does not appear in this issue, but appeared in one or both of the two previous issues

Kewanee Boiler Corp. 141
Kay Co., The 178
Kirk & Blum Co., The ..... *

Lee Rubber & Tire Corp., Republic Rubber Div. 42
Leslie Co. ..... *
Linde Air Products, A Division of Union Carbide and Carbon Corp. ..... *
Link Belt Co. ..... *
Liquidometer Corp., The 165
Lovejoy Flexible Coupling Co. 158
Lubriplate Div., Fiske Bros. Refining Co. ..... *

Manhattan Rubber Div. ..... *
Marlow Pumps 134
Mason-Neilan Regulator Co. ..... *
Mercoid Corp., The 179
Milton Roy Co. 34

National Aluminate Corp. 9
New York & New Jersey Lubricant Co. 158
Niagara Blower Co. ..... *
Nicholson & Co., W. H. ..... *
Northern Blower Co. ..... *

Orr & Sembower, Inc. 29
Owens-Illinois Glass Co., Kaylo Div. 28

Patterson-Kelley Co., Inc., The 137
Peerless Pump Div., Food Machinery & Chemical Corp. 33
Pennsylvania Flexible Metallic Tubing Co., Inc. 59
Permutit Co. ..... *
Pick Manufacturing Co. 164
Pilbrico Jointless Firebrick Co. ..... *
Powers Regulator Co., The 61
Pratt Daniel Corp. ..... *
Preferred Utilities Mfg. Corp. .112
Pritchard & Co., J. F. 162
Proto Tools ..... *
Pulverizing Machinery Co. ..... *

Quaker Rubber Corp. 119

Raybestos Manhattan, Inc. Manhattan Rubber Div. ..... *
Raybestos Manhattan, Inc. Packing Div. 48
Refinite Corp. ..... *
Refractory & Insulation Corp. . 38
Republic Rubber Division of Lee Rubber & Tire Corp. 42
Research Corp. ..... *
Riley Stoker Corp. 22, 23
Rockwell Co., W. S. 170
Rockwell Manufacturing Co., Edward Valves, Inc. Subsidiary *
Rust-Oleum Corp. 35

Serco Co., Inc. 40
Schneible Co., Claude B. ..... *
Schramm Inc. 127
Silent Hoist & Crane Co. ..... *
Sims Pump Valve Co., Inc. 152
Sinclair Refining Co. 30, 31
Smooth-On Mfg. Co. 172
Snap-on Tools Corp. 142
Southern Coal Co. ..... *
Spence Engineering Co., Inc. ..155
Standard Oil Co., (Indiana) ...64
Standard Pressed Steel Co. 173
Steel Products Engineering Co., The Combustioneer Div. ..... *
Stewart-Warner Corp., Alemite Div. ..... *
Stockwell Transformer Corp. 126
Strong, Carlisle and Hammond Co. 166
Sun Oil Co. 107
Superior Combustion Industries, Inc. 130
Superior Electric Co., The ..... *
Syntron Co. 128

Taylor and Co., W. A. 6
Terry Steam Turbine Co., The ..135
Texas Co., The ..... *
Thermix Corp., The 32
Toledo Pipe Threading Machine Co. ..... *
Trane Co., The 147
Troy Engine & Machine Co. ..... *

Union Carbide & Carbon Corp., Linde Air Products, A Div. ... *
Union Chain & Mfg. Co. ..... *
Union Iron Works 39
United States Gasket Co. ..... *
Universal Atlas Cement Co. ... *
U. S. Hoffman Machinery Corp. *

Vogt Machine Co., Henry 167

John Waldron Corp. 136
Warren Steam Pump Co., Inc. .. *
Webster Engineering Co. ..... *
Weinman Pump Mfg. Co., The ..122
Wekster Thermometer Corp. 173
Western Precipitation Corp. .... *
Westinghouse Electric Corp., Stokers 63
Westinghouse Electric Corp., Sturtevant Div. ..... *
Westinghouse Electric Corp., Turbines 43
Weston Electrical Instrument Corp. 171
Wickes Boiler Co., The .Third Cover
Wiedeke Co., The Gustav ..... *
Wiegand Co., Edwin L. 123
Williams Gauge Co., The ..... *
Wilson Inc., Thomas C. 168
Wing Mfg. Co., L. J. ..... *
Worthington Pump & Machinery Corp., Multi-V Drive Sales Div. ..... *
Worthington Pump & Machinery Corp., Steam Turbine Div. ... 57
Worthington Pump & Machinery Corp., Vertical Turbine Div. ..139
Worthington Pump & Machinery Corp., Water Treating Div. ... 46
Worthington Pump & Machinery Corp., Pump & Compressor Merchandising Div. ..... *
Worthington Pump & Machinery Corp., Engine Div. 153
Worthington Pump & Machinery Corp., Feedwater Heaters & Deaerators Div. ..... *
Wright-Austin Co. ..... *

Yarnall-Waring Co. 44, 45, 46
York-Shipley, Inc. ..... *

Zink Co., John ..... *

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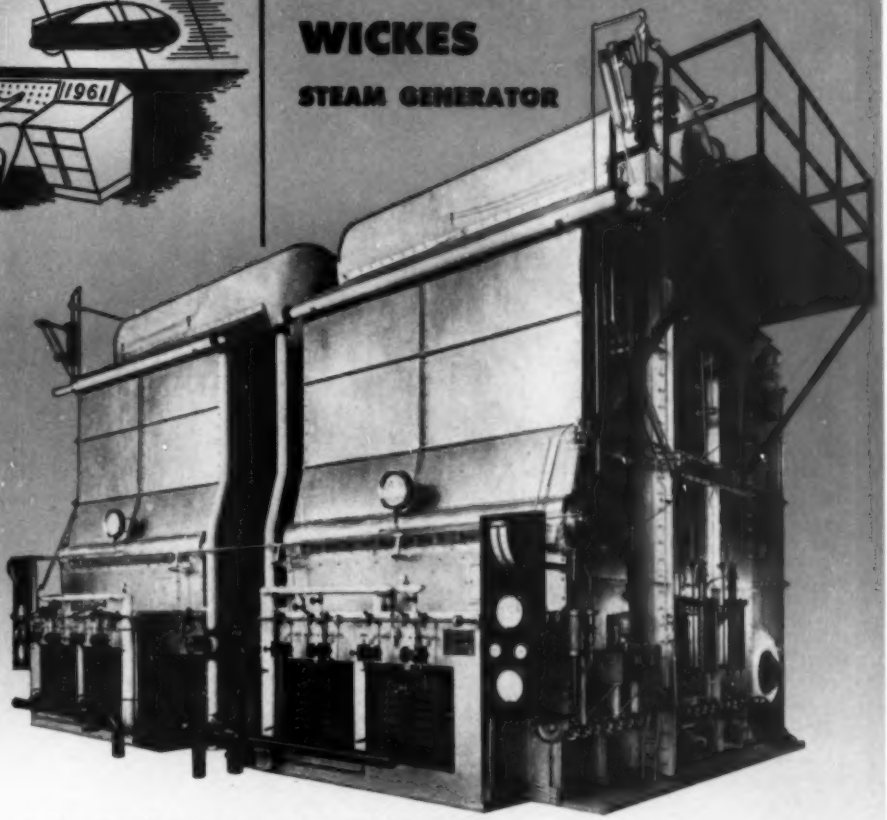

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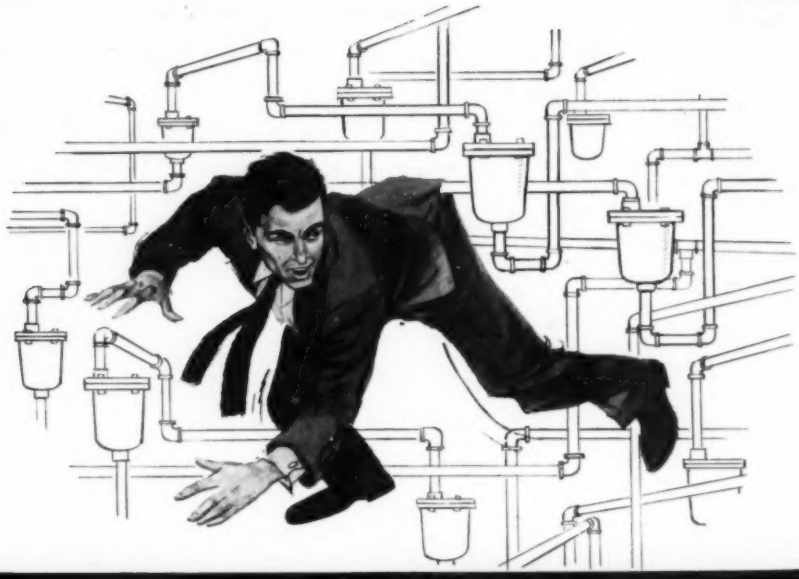

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